SCIENTIFIC AMERICAN

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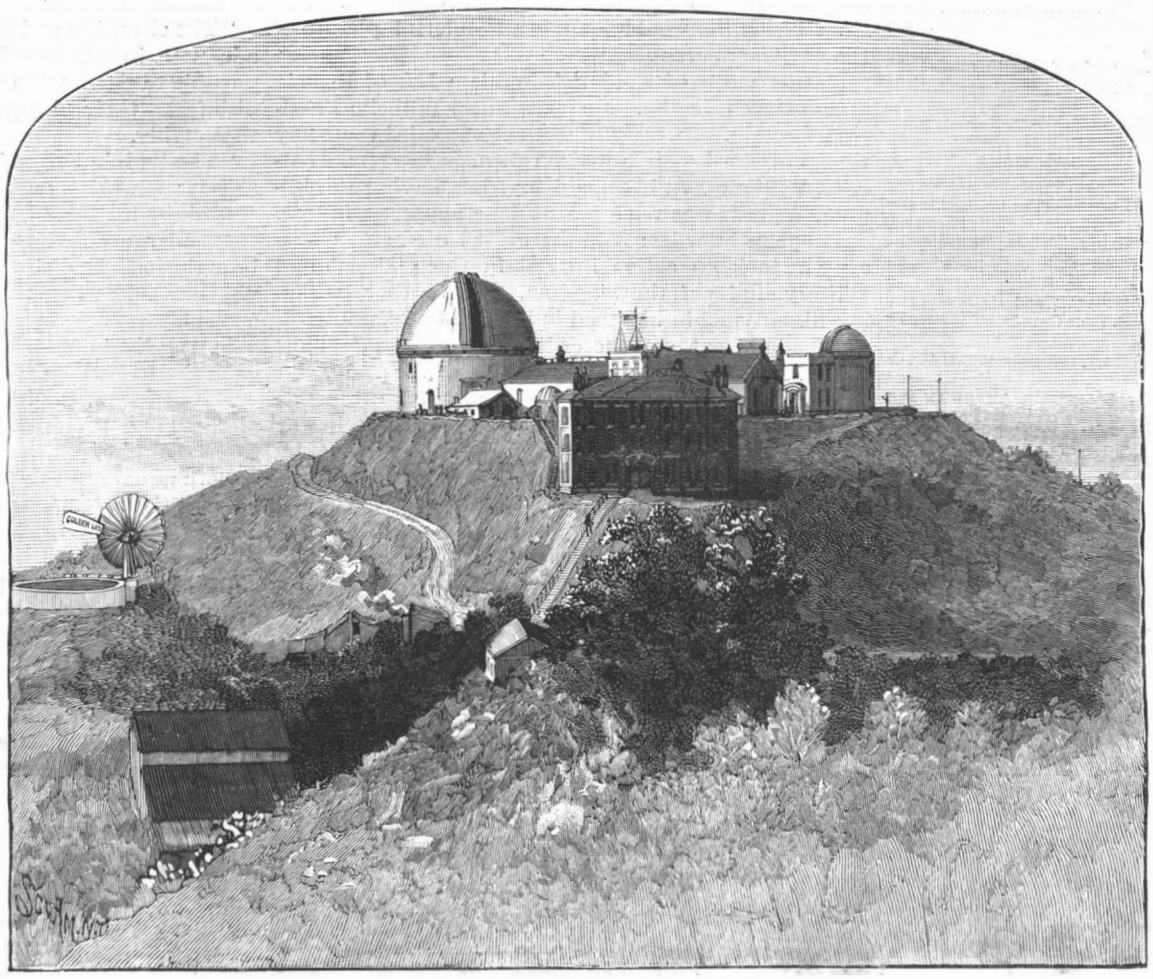
THE LICK OBSERVATORY OF THE UNIVERSITY OF CALIFORNIA.

James Lick, whose name has already acquired a world-wide fame as the establisher of the Lick Observatory, was born in 1798, in Pennsylvania. He led a somewhat adventurous life, and before he was thirty years old had accumulated a few thousand dollars. This he had made principally in South America, where he spent some years. In 1827 he went to California and visited the old mission town of San Francisco. The splendid harbor, the only one on many miles of coast, greatly impressed Mr. Lick, and he began purchasing land. Twenty-one years later, when gold had been discovered, and when the rush to California began, his investments acquired new value, and he ultimately became immensely rich. He was a man of very secluded habits, was a skillful mechanic, and, it is said, was especially fond of astronomy. Toward the end of his life he lived near San Jose, in the Santa Clara Valley. In 1874 he made over by deed to a body of trustees the sum of two millions of dollars for various public and philanthropic uses, and in 1875 made a revised deed to the same general effect. Besides various charitable donations, it included the following gifts: $150,000 for free public baths in San Francisco; $100,000 for statuary for the new City Hall of that city; $60,000 for a monument to Francis Scott Key, the author of "The Star Spangled Banner;" $540,000 to endow the California School of Mechanic Science in San Francisco; and $700,000 for procuring for the University of California "a telescope of greater power than any yet made." The total value of the trust fund was estimated at $5,000,000.

As the site for his observatory he selected Mount Hamilton, near his home in the Santa Clara Valley. He died October 1, 1876, aged 78 years. His body is interred under the base of the great telescope,

(*Continued on page* 162.)



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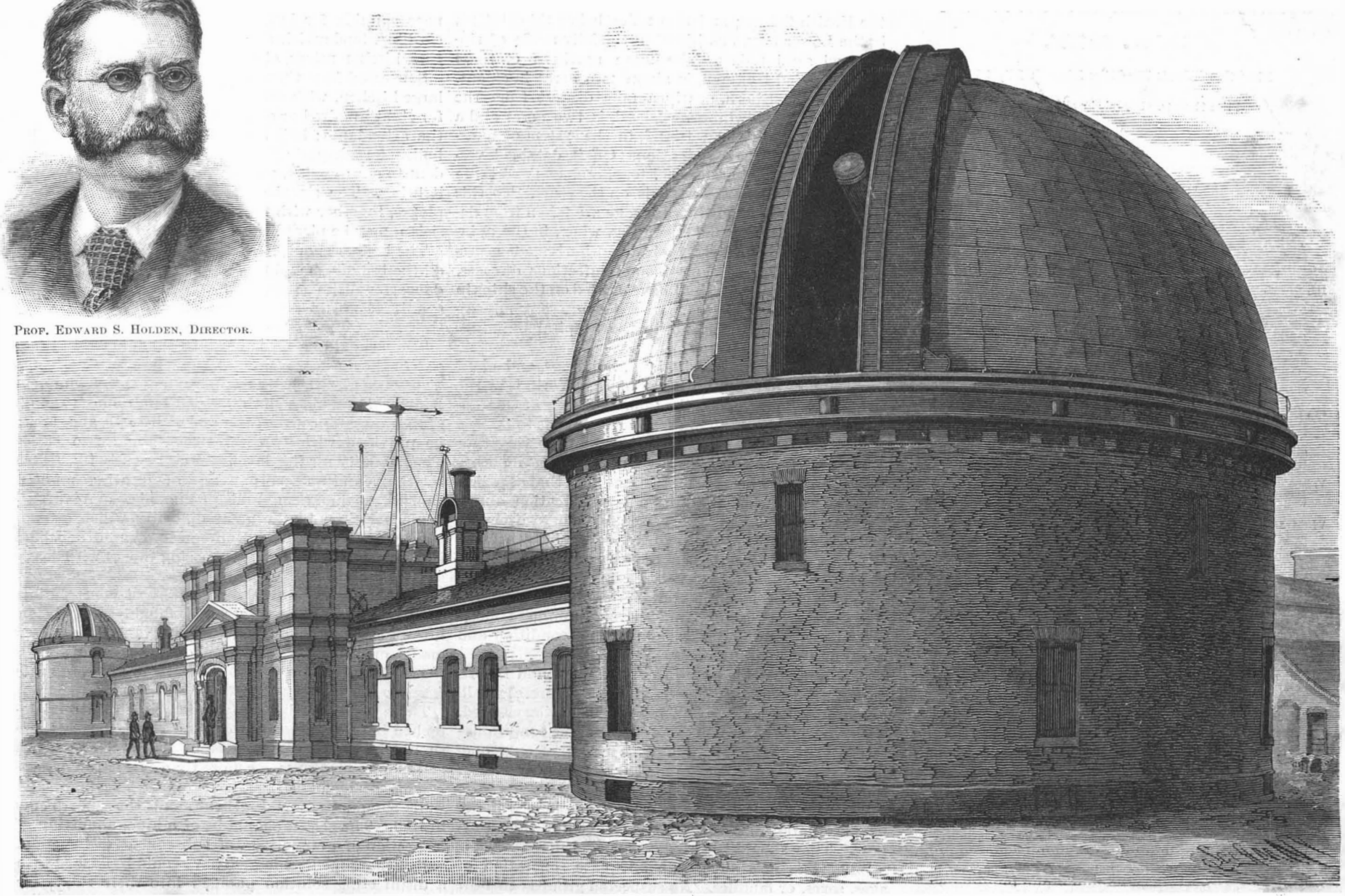

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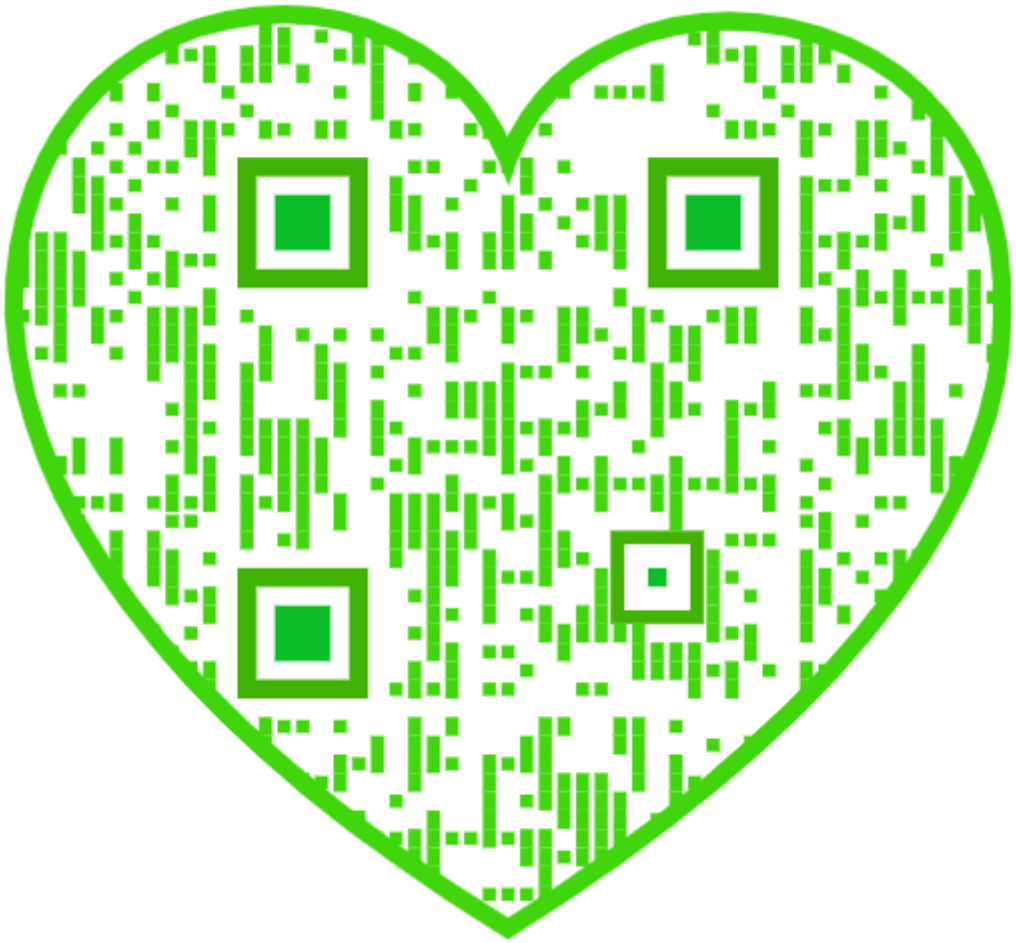

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Contents.

(Illustrated articles are marked with an asterisk.)

American trade and enterprise in Venezuela..... 168
Apantlesis..... 164
Blasting stumps, logs, etc., device for*..... 168
Books and publications, new..... 170
Brake block for vehicles, improved*..... 164
Business and personal..... 170
Button, collar or cuff, improved* 164
Cohesion of lead*..... 163
Correspondence..... 168
Earthenware, to perforate..... 161
Electric motor, simple*.....165, 166
Experiment, ingenious..... 164
Gate spring, improved*..... 164
Hay, unloading and stacking, device for*..... 164
Inventions, agricultural..... 170
Inventions, engineering..... 170
Inventions, index of..... 171
Inventions, miscellaneous..... 170
Lick, James*..... 163
Lick observatory of the University of California*.....159, 162
Lizard, horned, the*..... 169
Motor, electric*..... 165
Notes and queries..... 171
Onions, medical qualities of..... 161
Panama Canal, locks of*.....166, 167
Panama canal, the..... 168
Photographic notes..... 161
Photo-stereotype printing process..... 167
Progress of our Southern neighbors..... 169
Quarantine establishment, New York, deplorable condition of 160
Sand freezing process, the..... 169
Sheep bugs..... 167
Stand for displaying goods*..... 164
Sulphur fin vegetation, condition of..... 167
Valve plugs, truing, machine for* 168
William I., King of Prussia and Emperor of Germany..... 160

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 687.

For the Week Ending March 17, 1888.

Price 10 cents. For sale by all newsdealers.

PAGE

I. BOTANY.—A Large California Grape Vine.—A great vine, giving five tons of fruit at a crop.—2 illustrations..... 10181
Color in Plants.—The cause of plant color, its chemistry and negative relations..... 10180
The "Bleeding" of Plants.—Notes of recent investigations into this phenomenon..... 10182

II. CHEMISTRY.—Apparatus for Frictional Distillation under Reduced Pressure.—A simple arrangement for effecting this process of chemical work.—1 illustration..... 10177
The Chemistry of Substances Taking Part in Putrefaction and Antisepsis.—By JOHN M. THOMPSON, M.D.—The subject of antiseptics and prevention of putrefaction, with full formulæ and details..... 10177

III. CIVIL ENGINEERING.—Howe Truss Timber Bridge across the Willamette River, Albany, Oregon.—A great wooden bridge, including the largest wooden draw span in the world.—6 illustrations..... 10170
The Development of Bridge Construction, with Notices of Some Remarkable Historic Bridges.—By Prof. W. P. TROWBRIDGE.—A very elaborate review of progress in bridge engineering and notes of famous bridges of the world..... 10168
Timber and Some of Its Diseases.—By MARSHALL WARD.—A very elaborate treatment of this important subject, with investigations into the causes of decay.—6 illustrations..... 10172

IV. ELECTRICITY.—Improved Primary Battery.—By P. SELBY.—A very ingenious and simple construction of battery, principally from ordinary material.—5 illustrations..... 10175
The Position and Prospects of Electricity as Applied to Engineering.—By WILLIAM GEIPEL.—Continuation of this instructive review of the world of electrical progress..... 10175

V. MATHEMATICS.—The Polar Planimeter—Its Theory and its Use.—By E. A. GIESELER, C.E.—Mathematical discussion of this well known instrument for measuring areas.—5 illustrations..... 10174

VI. MECHANICAL ENGINEERING.—Improved Hydraulic Hammer.—A 300 ton hydraulic hammer or squeezer and its motive engine, with full dimensions of parts, on Higginson's direct system.—1 illustration..... 10171
Modern Improvements in the Steam Engine.—By SCOTT A. SMITH.—A paper read before the R. I. Engineers' Association, treating of modern practice and the work of Corliss..... 10169
The Vincennes-Ville Evrard Compressed Air Tramway.—An interesting review of a tramway that has worked successfully for nine years.—2 illustrations..... 10168

VII. MEDICINE AND SURGERY.—Catarrh of the Antrum.—Surgical treatment of this complaint by Dr. Schiffers, of Liege..... 10182
Mechanical Dentistry.—By Dr. E. E. SHATTUCK.—A review of the work to be done in this field..... 10181
The Etiology of Scarlet Fever.—By E. KLEIN, M.D.—The results of an investigation of this all-important subject, with special reference to its propagation by dairy products..... 10182

VIII. MISCELLANEOUS.—A Northwest Passage.—Project for closing Smith's Sound, Jones' Sound, and the three channels between North Devon and Melville Island, with a view to causing climatic changes..... 10179
The Spanish National Lottery.—New mechanical apparatus for throwing the numbers.—A curiosity in lottery progress.—The elimination of personal intervention in drawing.—1 illustration.... 10179
The Valley of Mogok—Ruby Mines District, Upper Burma.—The valley containing the famous Burmese ruby mines.—1 illustration..... 10180

IX. NAVAL ENGINEERING.—Lenoir's Petroleum Boat.—A description of this interesting little craft and of her engine.—2 illustrations..... 10171

X. OPTICS.—Experimental Optics.—Notes of Lord Rayleigh's recent lectures at the Royal Institution..... 10176

XI. TECHNOLOGY.—Glass Bottle Making by Machinery.—A new machine recently introduced in English glass works of wonderful simplicity, dispensing with the work of the glass blower.—1 illustration..... 10173

William I., King of Prussia and Emperor of Germany.

On March 9, 1888, the Emperor William I. of Germany breathed his last. His death occurred at about half past eight in the morning. He was born on March 22, 1797. A few days more of life would have brought him to the beginning of his ninety-second year. Less than a year ago his ninetieth birthday was celebrated with great pomp throughout the land, which now truly laments his loss. The peculiar principles of the Prussian house had done much to create a genuine feeling of loyalty among their subjects. The enlistment in the army and subjection to the severities of military discipline, to which the members of the royal family were subjected, gave a pleasing picture of self-denial. The story of his life would include a wonderful picture of the world's progress.

He was a son of Frederick William III. of Prussia and of Queen Louise. He was named Wilhelm Friedrich Ludwig. In early life he accompanied the army that contended with Napoleon I. His brother, Frederick William IV., became King, but having no children, William was regarded as heir apparent in 1840. Seven years later he sat in the united diet, and thereafter he took an active interest in the political and military affairs of the kingdom. His brother becoming ill, he acted in his stead in 1857, on October 9, 1858, was made regent, and succeeded him as King, January 2, 1861. He began the reorganization of the army, and in 1862 placed Bismarck at the head of his cabinet as minister of foreign affairs. The Schleswig-Holstein war leading to the convention of Gastein of August 14, 1865, the Austrian war of 1866, and the Franco-German war of 1870, in all of which his army was victorious, increased his power prodigiously, He was seconded throughout by Bismarck and Moltke. The former was appointed chancellor on July 1, 1867. The end of the French war, in the prosecution of which all the German provinces were united, was the unification of the empire. On January 18, 1871, at Versailles, a few months after the victory of Sedan, he was proclaimed Emperor of Germany. On May 10 of the same year the final treaty of peace with France was signed, and on June 9 the proclamation incorporating Alsace-Lorraine with the empire was ratified. The crown prince is now probably near his end, and the imperial throne may soon be filled by the grandson William, on his mother's side a grandson of Victoria.

Deplorable Condition of the New York Quarantine Establishment.

The quarantine establishment, port of New York, consists of the landing station at Clifton, Staten Island, where vessels arriving receive the official inspection of the Health Officer; and two miles below this station, in the Lower Bay, two islands artificially made of riprap and sand filling. The more northern of these islands, called Hoffman, is about two acres in extent. The more southern, nearly a mile distant from the former, named Swinburne Island, is two acres and a half in size. Hoffman Island, in the system of quarantine, is the place of detention. Off it detained vessels are anchored in the roadstead, and exposed there to heavy sea when the wind is on the coast. To this island passengers and their luggage are taken from detained vessels by a small steam tug, when, in the opinion of the Health Officer, their detention is made necessary by prevalence among them of infectious diseases, or when such diseases shall have existed on the ships in which they have arrived. The sick are sent immediately to Swinburne Island, to the hospital buildings which exist there.

The quarantine property, land, buildings, and plant generally, owned by the State of New York, is in the custody of a body called the Commissioners of Quarantine, appointed by the State and responsible to it. The Health Officer of the port, appointed by the Governor of the State and confirmed by its Senate, has no other control of the property and stations than that of police. He may use it without addition or modification, and so far only as may be necessary to enable him to discharge his duties in preventing the introduction into the port of New York of contagious diseases or infectious substances.

In November last the New York Academy of Medicine appointed a committee of seven prominent medical men to visit and report upon the condition and needs of the quarantine establishment.

Of Hoffman Island they say: "The ground is soft, uneven, full of recesses in which water, refuse, etc., will be retained without any chance of their being cleaned. The wood walks are in the worst possible condition—interrupted, broken, rotten. The riprap of only one-half of the island is now supported by an inside wall of cement.

"The present buildings used for the residence of the people quarantined are badly adapted for their purpose. They should be razed or remodeled.

"There is now almost no adequate separation of ages, sexes, or families. No suspected groups can now be isolated. There is no opportunity at all to separate those who may be amply able and willing to pay. There are no proper accommodations, bedsteads, bedding, tables, forks, knives, spoons, plates or towels. As an instance of the hardships caused by want of means of isolation, a steamer is at present detained at quarantine, owing to the passengers and crew having been exposed to smallpox. They cannot be taken on the island, as there is no subdivision of the Hospital of Observation.

"The supply of water is insufficient, and warm water is almost entirely wanting.

"For a population now there of more than five hundred persons, there are about four water closets, each closet having three or four hoppers, some of which are not flushed at all, and all of which are old, badly constructed, and out of repair.

"The cleansing and disinfecting plant is entirely inadequate, in extent and efficiency, thus making it impossible to cleanse the persons of the quarantined or disinfect their luggage, either expeditiously or thoroughly.

"The 'sulphur room' should not be where it is and as it is; for, being on the main floor of a building occupied by masses of the quarantined, the latter are constantly exposed to fresh infection from clothing brought in to be disinfected, and to the fumes of sulphurous acid when the door of the sulphur room is opened."

Among the improvements needed, the committee suggests the following:

The surface of the island should be cemented or asphalted, and should be raised sufficiently above the exterior wall to allow of good drainage. It should be smooth and hard to allow of thorough cleansing, and prevent the lodgment of filth or germs.

If the present large buildings are to remain, the roofs should be repaired. Each main floor should be subdivided into two or more portions by solid partitions, to allow the grouping of the inmates according to age, sex, and relationship. Each apartment should have a separate entrance and be thoroughly ventilated. This method should be condemned, however, unless absolutely unavoidable, as poorly ventilated apartments would result. The best plan, and, in the opinion of the committee, the only sanitary one, would be to construct new fire and filth proof buildings, tearing down the old ones as speedily as possible, or, if need be, one at a time.

The present administration building should either be remodeled or a new one erected. Reconstruction will prove costly and unsatisfactory, and a new building would be better. It should contain the medical officer's apartments (who should also be superintendent) and quarters for an engineer, and with private kitchen; also an extension on one of the docks, the disinfecting plant, storage rooms, laundry, etc., together with a furnace suitable for burning actually infected bedding, clothing, food articles brought in by infected passengers, kitchen refuse, etc.

Separated from these apartments there should be a large kitchen, with accommodations for cooking meals for eight hundred or one thousand persons; rooms for the attendants; boiler room, containing at least two boilers for adequate power and security in case of accident to one; engine, pumps, and apparatus for electric lighting. The sleeping and living rooms for the employes, together with three rooms for the resident physician, may be placed in a separate building.

The boilers should be of sufficient capacity to heat all the buildings, and to furnish steam in great abundance for disinfection, cooking, and washing. They should, if possible, be placed in a separate building, or the present one be devoted to their use.

There should be a small isolated building, easy of access to the dock, where persons taken suddenly ill could be at once placed, prior to their removal to Swinburne Island. It should contain at least four rooms, to admit of the separation of the sexes and of diseases, and should be provided with two water closets and two baths. The necessity for this hospital was recently illustrated by the simultaneous presence of measles, mumps, cholera, rheumatism, and pneumonia, and further made necessary by the great difficulty which attends conveying the sick from Hoffman to Swinburne Island in stormy weather, against opposing tide or with heavy sea.

Soil pipes and sewers should be of best construction, with absolutely tight joints, and should empty below low water. There should be a flushing tank of approved model provided for each line of sewer. *No sewage should be allowed to pass to the bay without being subjected to chemical treatment.*

There ought to be many water closets in semi-detached buildings or small towers. If the latter, there should be nine buildings—eight for detained persons and one for employes—or more than this if the passengers are divided into smaller groups. The floors and walls should be non-absorbent, and the apartments heated. The closets should be of a kind admitting of inspection of evacuations, of subsequent disinfection, and of thorough flushing. They should be flushed with a disinfecting solution pumped into their respective reservoirs by steam pumps in the administration building.

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The lavatories should be in semi-detached buildings, properly warmed and ventilated, and should contain stationary bath tubs and a few portable ones, and in sufficient number to bathe five hundred persons in one day. They should also contain fixed basins of the most approved pattern, and in such number as to facilitate rapid use. Slop sinks should be provided in a separate apartment, and sinks for dish washing should be off the dining room.

The laundry should be in a building with accommodations for washing the bedding and clothing of eight hundred or one thousand persons. It should have stationary but not wooden tubs; also boilers, rinsers, wringers, and all the modern appliances, supplied with steam. There should be a capacious dry steam drying room, and all of sufficient capacity to pass through the clothing of eight hundred or one thousand immigrants in as short a time as possible.

Each pavilion or apartment should be provided with iron beds, wire mattresses, bedding, tables, chairs, etc., of the best models, the latter so that detained persons need not be forced to sit or lie upon the floor during the day. Bedding should be simple in quality, abundant in quantity, and kept scrupulously clean, and when not in use carried to a suitable place for airing and storage.

Dishes, spoons, knives, forks, and all such necessary articles should be provided, and should be kept in the custody of the emplooes, except when in use, and be cleaned by the employes and not by the detained persons.

If the present buildings are to remain, a space could be partitioned off in one corner of each of the large rooms, with accommodation for twenty-five or fifty sitting at a narrow table. They should be accessible from the hallway, not from the main rooms, and should be kept locked except during meals. With separate buildings or pavilions, provision could be made in a central building for serving meals at separate tables to those in the different rooms.

Complete simple suits of clothing should be provided for the temporary use of immigrants during the disinfection of their own clothing and baggage, and such clothing should be carefully cleaned, or, in case of suspected infection, destroyed.

There should be an abundant supply of towels for the wash and bath rooms.

The disinfecting plant should be located in a separate building near the water's edge. The plant should consist of two or more large iron cylinders or chambers. These should be lined with steam pipes connected with a superheater, so that a dry temperature of at least 220° Fah. could be easily obtained. It should be arranged so that moist steam under fifteen or twenty pounds pressure could be introduced.

The sources and collection of water needs careful consideration, as a plentiful and pure supply is of the first importance. It would be wise to fill up the present cisterns and construct new ones, with every safeguard against contamination. The water used for drinking, cooking, washing utensils, dishes, etc., should be above suspicion, and, at stated times, critically examined. All collections of water should be carefully protected from surface drainage. Rain water for storage should be taken from roofs not liable to possible contamination. It would be well to provide for an emergency by having a large reservoir to which water could be brought in case of drought. Water for drinking and cooking might be brought in water boat from the Croton supply.

Some provision should be made to relieve the tedium that must befall a large shipload of passengers who, after encountering the dangers and sufferings of an ocean voyage, are unwillingly detained in full sight of their port for a considerable period of time, or it may be until the fact has been made clear that they are or are not to be victims to a dread disease.

There should be at time of occupation a resident medical officer on the island, who should be superintendent, and also skilled in every detail of modern sanitary science.

The approach to Swinburne Island is defective, owing to a bar between it and Hoffman Island. It is difficult to land the sick, as there is no protection from the wind.

The present pavilions are too low on the ground, and with little or no air space beneath the floors. The floors of all the wards are defective. The ground beams are giving way, and there appears to be no ventilation underneath.

The wards are lacking in ventilation, there being no adequate roof ventilation. At present the air currents are likely to be blown from one ward into another.

The remains of patients who have died of contagious or infectious disease should be subjected to such processes as would render them, before burial, innocuous, and prepare them for a decay which would not imperil the living.

The islands are small. The buildings are all most combustible. A fire occurring on Hoffman Island, crowded as it was last autumn, would have driven panic-stricken men, women, and children into the sea.

This danger is equally great on Swinburne Island, though it is probable that the crowding there will never be so great. The more helpless condition of the sick, however, in hospital wards would increase their peril. The fire apparatus in both places is entirely insufficient. The limited area of each island would make any fire apparatus insufficient if the buildings happened to be crowded and a high wind were prevailing at the time of the conflagration. All buildings on such islands for similar purposes should be fireproof.

As a related matter we would allude to the possible effect produced upon the business interests of New York and the country at large, if cholera were permitted to invade the dense population of the city. It is estimated that about one hundred thousand dollars a day are received by those hotels in the city of New York from which people would flee if an alarm of cholera existed there. The amount of money received over the counters of shops from those who frequent the city to buy its innumerable wares cannot be estimated. It is millions. Hundreds of millions of dollars are annually produced in values in our various factories. To disturb the peace and industrial interests of the city, by permitting the irruption of cholera through defects in quarantine, would inflict an injury upon business beyond computation.

The time consumed in reaching San Francisco by railroad is about that of the possible maximum period of incubation of cholera. The germs of any of the contagious diseases admitted into the port of New York by inadequate quarantine might be conveyed to any portion of the United States, fructifying as they went. Every citizen in the United States and British provinces has, therefore, a personal interest in the condition of the New York quarantine. The existence of cholera in New York would cause the entire country to quarantine against the city. In this way interstate commerce would be paralyzed or seriously embarrassed. As regards the effect upon the health and death rate of the people we cannot even surmise, as that question would turn on the efficiency of the sanitary police. The law of cholera, its propagation, limitation, and extinction, are so well understood that the disease may be said, without presumption, to be subject to scientific prevention or control.

If there is neglect in this matter, and cholera, which has threatened to invade our port for more than three years, and has recently been brought to quarantine, should appear in the spring, and, favored by warm weather, pass an imperfect quarantine and reach New York City or Brooklyn, or possibly extend beyond to near and remote places, public opinion would seek out the blameworthy and visit them with a condemnation which no seclusion would be deep enough to smother or mitigate.

PHOTOGRAPHIC NOTES.

Making Portraits Indoors.—In a communication received from a correspondent who has experimented in taking photographs indoors, he states that he has succeeded in making excellent portrait negatives, equal in fact to the results usually obtained under a skylight, as follows:

"Select a good sized north window, place the sitter about three feet back from the window, and hang up in the rear of the sitter some gray material for a background, also hang up a white sheet a few feet from the sitter on the dark side to reflect as much light as possible, then arrange the camera and stop down the lens so as to give say from four to eight seconds' exposure. Have a mirror, size about 2 feet by 3 feet, ready within reach, and immediately upon removing the cap from the lens seize the mirror, and with it direct the light upon the dark side of the sitter's face, giving the mirror a swaying motion during the exposure. When sufficient exposure has been given, put down the mirror and cap the lens. The sitter should be cautioned against following the movements of the mirror with the eyes."

Some recent experiments made with the magnesium flash light show that it can be utilized to good advantage in making portraits beside a window as above described, in a much shorter time. The light takes the place of the mirror. By placing the light compound on a table five feet away from the person, in such a position as to equally illuminate the shadow side, it is only necessary in making the exposure to quickly remove the cap from the lens, set off the flash light, and immediately recap the lens. It is advisable that the subject get accustomed to the suddenness of the flash, by making one or two preliminary flashes before exposing the plate. The lighting of the shadow portion of the face is very easily controlled, for if the light is flashed close to the sitter, the shadow will be less, but if flashed quite a distance away the shadow will be greater. Hence any degree of softness or balance between the daylight on the one side and shadow on the other is readily obtained.

Toning of Silver Prints.—In a communication to the Derby Photographic Society, Mr. Edward J. Lovejoy says: I have chosen the "Toning of Silver Prints" as the subject upon which to offer you a few remarks this evening, and trust that what little information you may gain from them may be of use to some of you. As a preliminary to toning, I may mention that the color of the print is much influenced by the character of the negative, also that unless you get a good negative—that is, one having a wide range of tones—you cannot get a good silver print. Allowing that your negative is all that can be desired, and after printing somewhat deeper than the finished print is required to be, in order to allow for loss in the subsequent operations, the print is removed from the printing frame, trimmed, and put into a dish of water to dissolve out all the free silver, frequently changing the water till it no longer shows signs of milkiness, then place it into another dish of water in which a little common salt has been previously dissolved. This converts any remaining free nitrate of silver into chloride, which is afterward dissolved out of the film in the fixing bath. I believe the salt bath to be very essential, and for this reason: it causes the prints to take a little longer to tone, by which they get a much finer deposit of gold on their surface, which adds to their permanency.

After the print has been in the salt bath a few minutes it is rinsed again in water, and is ready for toning. There are several kinds of toning baths, with nearly all of which excellent results can be obtained. I will here, however, give you the formulæ for two only, both of which I use myself, and get very good results: Chloride of gold, one grain; acetate of soda, twenty grains; water, eight ounces. This should be made at least twelve hours before using. The other is: Chloride of gold, one grain; water, twelve ounces; borax, half an ounce. Sufficient bicarbonate of soda should be put into the gold solution to neutralize any acid that may be in it. This bath may be used as soon as cold, for it is necessary to dissolve the borax in hot water, and, when cold, add the gold to it. This is an important point—*the gold must be added to the borax, and not the reverse.* The print is now placed in the toning bath, printed side down, and moved about to expel any air bells which may have adhered to the under surface, and it is well to keep the solution in motion till toning is completed, as, where there are a number of prints in the bath, it causes the gold to deposit equally on all.

The print should remain in the bath till of a fine purple tone, which usually takes from twelve to fifteen minutes, and I recommend the bath to be used at a temperature of about 70° Fah. The print is then taken out and placed in a solution composed of methylated spirit four parts, water one part. This will prevent blisters from appearing on the print, which is a source of great trouble, and very prolific with some brands of ready sensitized paper. It is then put into the fixing bath, made of hyposulphite of soda, two ounces; water, twenty ounces; liquor ammonia, fifteen drops. Fixation will be complete in fifteen or twenty minutes, when it should be taken out and washed in repeated changes of water, in each of which it should remain five minutes, and between each change it should be laid upon a piece of plain clean glass, face down, and a squeegee passed over the back—this is a very effectual way of removing the hypo. out of the print—then wash in running water for several hours.—*Reported in Br. Jour. of Photography.*

Medicinal Qualities of Onions.

The free use of onions for the table has always been considered by most people a healthy and desirable vegetable, and but for their odor, which is objectionable to many, they would be found more generally on our dining tables.

For a cold on the chest there is no better specific, for most persons, than well boiled or roasted onions. They may not agree with every one, but to persons with good digestion they will not only be found to be a most excellent remedy for a cough, and the clogging of the bronchial tubes which is usually the cause of the cough, but if eaten freely at the outset of a cold, they will usually break up what promised, from the severity of the attack, to have been a serious one.

A writer in one of our medical journals recently recommended the giving of young raw onions to children three or four times a week, and when they get too large and strong to be eaten raw, then boil and roast them, but not abandon their free use.

Another writer, advocating their use, says: During unhealthy seasons, when diphtheria and like contagious diseases prevail, onions ought to be eaten in the spring of the year at least once a week. Onions are invigorating and prophylactic beyond description. Further, I challenge the medical fraternity or any mother to point out a place where children have died from diphtheria or scarlatina anginosa, etc., where onions were freely used.

To Perforate Earthenware.

A method which is said to be very satisfactory is recommended by Professor Stuart as follows:

Instead of a drill a soft copper rod or pipe is used in the lathe, it being fed with a mixture of powdered emery and linseed oil. The emery is embedded in the copper by the friction, and cuts right through the hardest material in a very short time.

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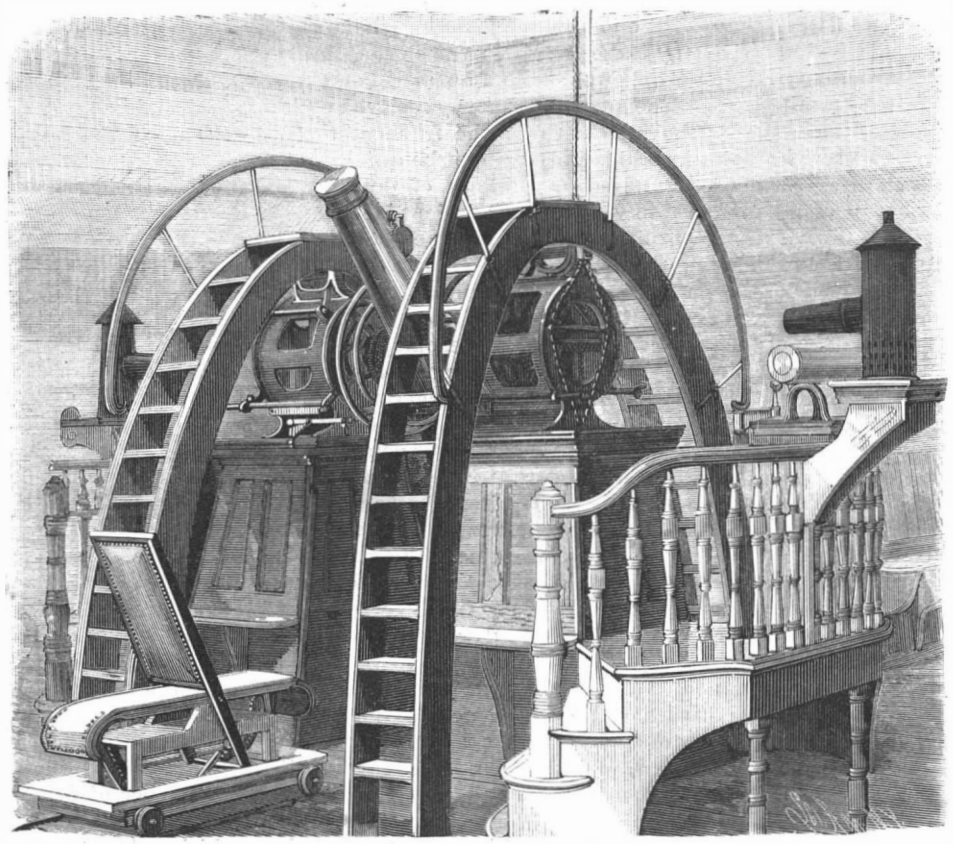
THE LICK OBSERVATORY.

(*Continued from first page.*)

which rises above his remains as a fitting monument to one of the world's greatest benefactors and philanthropists.

In administering their trust the custodians met with legal obstacles and suits brought by his relatives. These delayed the carrying out of his plans, but eventually a settlement was reached. On June 30, 1883, the corner stone of the observatory, to which this article is devoted, was laid, and to-day the work is practically complete. When Mount Hamilton was selected as the site for the Lick Observatory, in order to test its atmospheric conditions, Professor S. W. Burnham, the discoverer of many double stars, was invited to observe there in 1879. Owing to the dryness of the air, and its excellent quality for astronomical work, his six inch telescope described many stars, catalogued by Professor Otto Struve as double, into triple stars. Mr. Lick died in 1876, and the original plans for the observatory were determined by Captain Richard S. Floyd, president of the trustees, and Mr. T. E. Fraser, superintendent of construction, acting under the advice of Professor Edward S. Holden, and Professor Simon Newcomb, of the Naval Observatory, in Washington. Many noted astronomers have been interested in the work, and this will probably be the most famous observatory in the world. It owns about 1,550 acres of land, a portion of which will eventually be made into a public park, and the graded road of twenty-six miles leading to the summit of Mount Hamilton from San Jose may, perhaps, become a direct route to the Yosemite Valley. Since 1880, when the work was first begun, 7,000 tons of rock and earth have been removed to level a plateau upon which the buildings stand. They are constructed of solid masonry, and are of simple but effective architecture, and include the main building—287 feet long—containing the directors' and secretary's offices, the library, clock rooms, etc., with the large dome at its southern end for the large telescope, and a smaller dome for the 12 inch equatorial at the northwest corner, the meridian circle house, the transit house, the photographic laboratory, and several temporary wooden workshops. The dwelling house of the astronomers, 63 × 60 feet, stands below the summit and is connected with the plateau by a bridge. The surrounding peaks have been named from several famous astronomers.

In speaking of the outlook from Observatory Peak, which is 4,302 feet in height, Professor Holden says: "It would be difficult to find in the whole world a more magnificent view than can be had from the summit just before sunrise, on one of our August mornings. The eastern sky is saffron and gold, with just a few thin horizontal bars of purple and rosy clouds. The sharp outlines of Copernicus and Kepler are seen in sharp profile against the brilliant background. Orion, Procyon, the Twins, Sirius, are in the morning sky, and Venus is brilliant and steady against the stars. The instant the sunbeams touch the horizon the whole panorama of the Sierra Nevada flashes out, 130 miles distant. Toward the south and west the beautiful valley of Santa Clara lies, dotted with farms and vineyards, and bordered toward the sea by Loma Prieta and the Santa Cruz Range. The winding road to San Jose, which takes twenty miles of twisting to accomplish the thirteen miles of air line, lies like a dusty snake at your feet. The Bay of San Francisco looks like a piece of a child's dissecting map, and is lost in the fogs near the city. The buildings of the city seem strangely placed in the midst of all the quiet beauty and the wild strength of the mountains. Then you catch a glimpse of the Pacific in the southwest and of countless minor ranges of mountains and hills that are scattered toward every point of the compass, while, if the atmosphere is especially clear, you can plainly see to the north Mount Shasta, 175 miles distant."

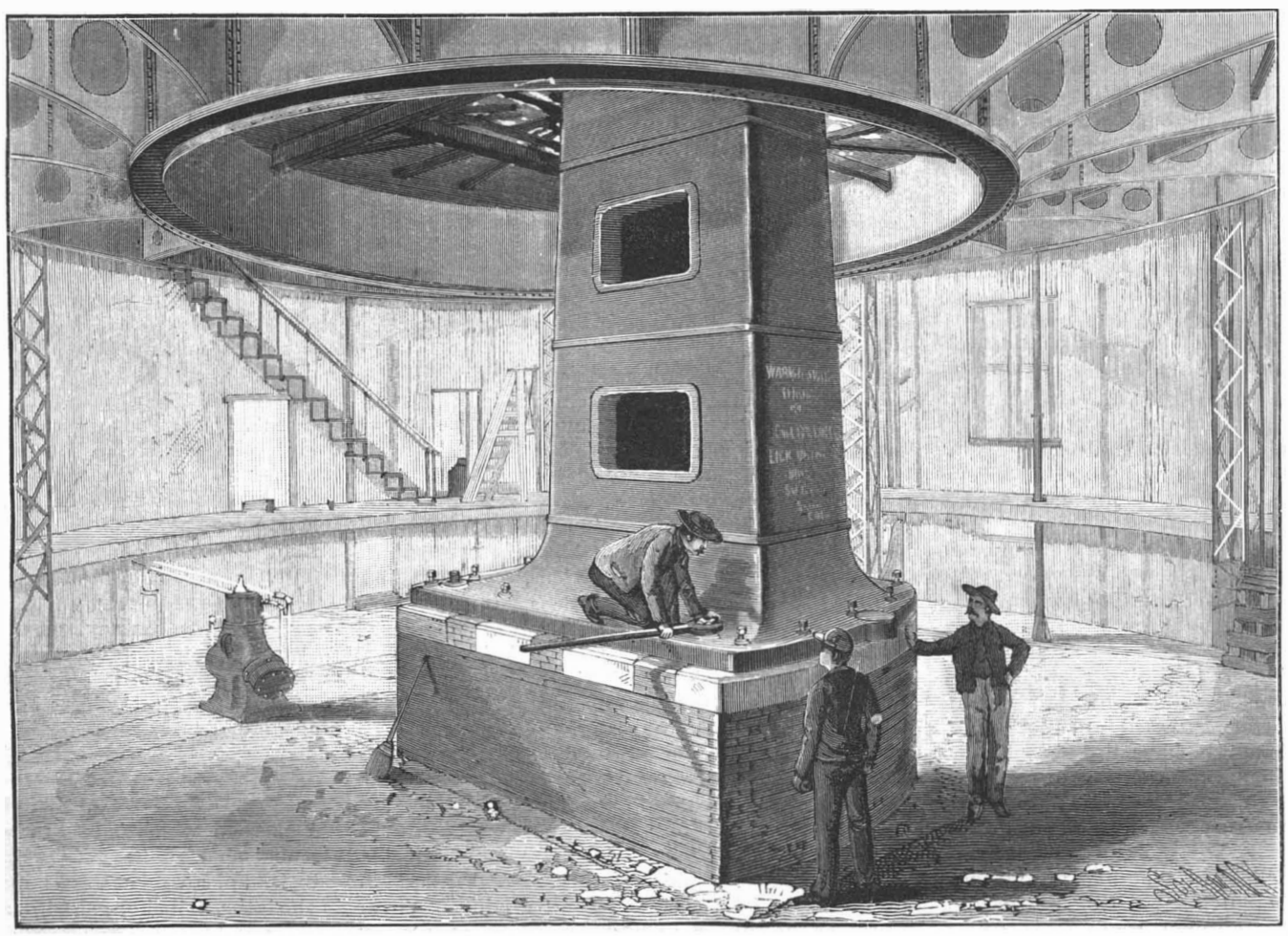


LICK OBSERVATORY—THE MERIDIAN INSTRUMENT.

The large dome, built by the Union Iron Works, of San Francisco, is 75 feet in diameter and its moving parts weigh 100 tons. It revolves upon wheels which run on hardened steel balls. A man merely pushing against it can move the entire dome. The usual motive power is obtained from a water engine which can rotate the dome 360° in less than 9 minutes. Its diameter changes ½ inch in the extreme change of temperature, and its track is given a smooth and oiled surface to slide upon. The observing slit is 9½ feet wide, and the pintle of the shutter is placed eccentrically. A practical device for carrying the observer to the eyepiece of the telescope, which at times is far above the base of the dome, was planned by Sir Howard Grubb, of Dublin. This is an elevating floor 61½ feet in diameter, weighing 50,000 pounds, and is moved up and down through a space of 16 feet. It is highly probable that the present system will not be sufficiently powerful to raise the flooring rapidly enough, but in this event the hydraulic system can be altered, or steam or electricity substituted. The actual speed required can only be determined after a series of experiments have been made.

The dome for the 12 inch equatorial is 25 feet wide, weighs 8 tons, and its observing slit, which extends beyond the zenith, is 3 feet wide. The meridian circle house is 43×38 feet. Its walls are double, the outer frame of galvanized iron, the inner one of California redwood. Between these is an air space 24 inches wide, which encircles the buildings. There is also an air space above the ceiling, which communicates with the room and with the air spaces of the walls, and on the west there is a ventilating tower two stories in height, which connects with the room of the meridian transit instrument. By these means the temperature of the building is kept the same as that of the external air. The transit house adjoining the meridian circle house is built of iron, with a wooden lining, and is arched by a curved shutter, which is controlled by levers, planned by Sir Howard Grubb. The photographic observatory, north of the transit house, is a small wooden building, with brick foundation. The tube of the photoheliograph telescope enters this house, and a brick pier supports the photoheliograph. A room in the second floor of the main building is also fitted for photography.

The large telescope, which embodies the expressed object of the $700,000 donation, was mounted by Warner & Swasey, of Cleveland. The tube is nearly cylindrical, and is 60 feet in length. There are three finders, 6, 4, and 3 inches in aperture, and in addition to these the 12 inch equatorial can be quickly attached, as a pointer, for photographic work if the controlled driving clock does not work satisfactorily. The lens is 36 inch clear aperture, being the largest object glass in the world, and has a 678 inch focus. The flint disk was obtained from Feil, in April, 1882, and after nineteen failures the crown glass disk was cast successfully in September, 1885. The third photographic crown lens was purchased from Feil in 1886, and broke while in the hands of the Clarks. The trustees of Yale University then offered their 27 inch flint glass to the Lick Observatory, but this was too yellow, and in 1887 Mr. Alvan G. Clark bought in Paris, from Feil, the crown glass, which is worked into a third lens. In addition to its magnifying power and its perfect definition, *i. e.*, neatness, accuracy, etc., this telescope has great light-gathering power, and stars may be seen thro' it which are 30,000 times fainter than the faintest seen by the naked eye, and the moon will appear under the same conditions as if it were seen by the naked eye at about 200 miles from the earth.



THE ELEVATING FLOOR—RAISED—AND THE GREAT TELESCOPE PIER.

It is interesting to compare this telescope with the simple instrument made by Galileo in 1609, consisting of a single leaden tube with a plano-convex lens at one end for an object

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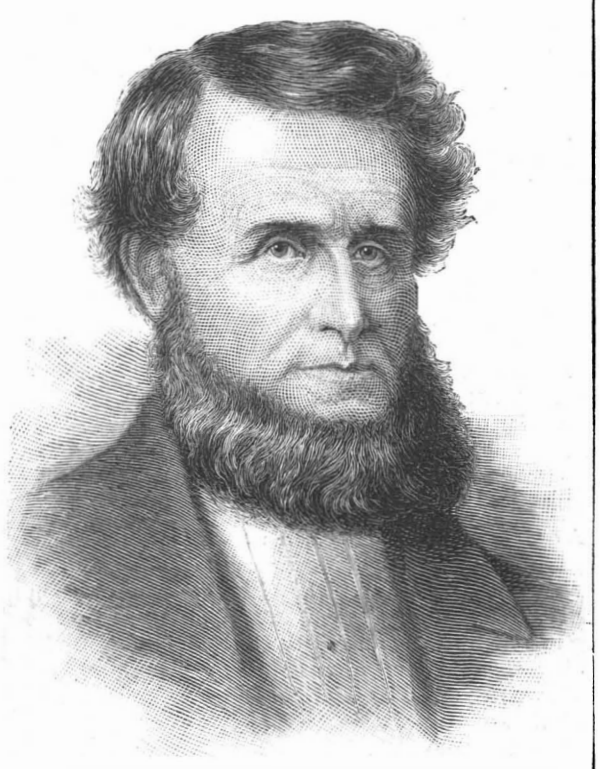
glass, and a plano-concave lens at the other end for an eyepiece, and magnifying three times. Ever since Galileo's brilliant discoveries with this "optick tube," described by Milton in his visit to Padua, the growth of the telescope has been of steady progress, in spite of the opinion of a cotemporary professor of Galileo in the University of Padua, who argued that "things invisible to the naked eye are useless and do not exist." In tracing its development briefly we find that the difficulties in obtaining good glass led Newton to construct a reflecting telescope in 1688, which magnified 39 times, the speculum or mirror being made of an alloy of copper and tin. Improvements followed which finally resulted in Herschel's finely constructed instruments, in the large six foot reflector in its gigantic frame, made by Lord Rosse, and in the celebrated reflectors of the present time. The reflecting continued to supplant the refracting telescope until about 1753, when Dolland, an English optician, showed that lenses of flint and crown glass could be combined in such a manner that their dispersive powers would neutralize each other, and this is the principle of construction of the achromatic objective now in use, consisting of an outer double convex lens of crown glass and an inner lens nearly plano-concave of flint glass.

The 12 inch refractor, which was originally made for Dr. Henry Draper's private observatory at Hastings, N. Y., by Alvan Clark & Sons, is of the finest construction. The object glass of the 6½ inch equatorial was also made by the Clarks, and is provided with a portable mounting made by Warner & Swasey. The 4 inch comet seeker, made by Alvan Clark & Sons, has a focal length of 33 inches. The rays fall on a reflecting prism, and are bent into a horizontal plane. The eye of the observer moving in azimuth while the telescope is in altitude can cover the whole sky. The motion is effected by turning a crank. This was bought on Prof. Newcomb's recommendation.

The photoheliograph is mounted south of the transit house. The transit instrument determines the axis of the photoheliograph, and this is also used as a collimator for the transit. The 6 inch Repsold meridian circle was delivered in 1884, after having been inspected by Profs. Auwers and Krueger, of Berlin. The declinograph was made under the supervision of Dr. Johann Palisa, of Vienna, to fit either a 12 inch or 6 inch equatorial. The universal instrument made by Repsold consists of a telescope containing a prism, into which the rays of light are reflected. Its aperture is 2·15 inch. The horizontal circle reads by two microscopes to 2", and the circles are 10 inches in diameter. This is a perfect geodetic instrument, and together with a 6 inch equatorial and a chronometer can be easily packed for astronomical expeditions. There are several chronometers made by Negus, and a thermometric chronometer by C. Frodsham. The most important of the minor instruments are the filar micrometer for the 36 inch telescope by Fauth & Co., the duplex micrometer by Grubb, and a star spectroscope made by Brashear from designs of Mr. Keeler. Plans for a large solar spectroscope are being worked out by Prof. Holden and Prof. Langley. The other instruments are a delicate sphereometer by Fauth & Co.; resistance coils; galvanometers; a disk photometer; spectroscopes; a lever trier of refined construction; and an engine for measuring photographs, scales, etc., made by Stackpole & Bros., from designs of Prof. Harkness.

The meteorological instruments are: Self-registering rain gauges, wind gauges, barometers, and a number of thermometers. There is a complete set of apparatus for registering earthquakes, provided by the Cambridge Scientific Instrument Co., consisting of a horizontal seismograph with clock and driving plate, the clock being started by an electric contact at the beginning of a shock, and the two rectangular components of the horizontal motion then registering on a moving plate; a vertical seismograph to register vertical motions on a dial plate; a duplex pendulum seismograph to give independent records on a dial plate, the pencil being free to move in any azimuth; and a chronograph, which is set in motion at the beginning of an earthquake and records its duration upon a clock. The staff of the observatory consists of Prof. Edward S. Holden, director and chief astronomer; Samuel W. Burnham, James E. Keeler, John M. Schaeberle, and Edward E. Barnard, assistant astronomers; and C. B. Hill, secretary, librarian, and occasional observer.

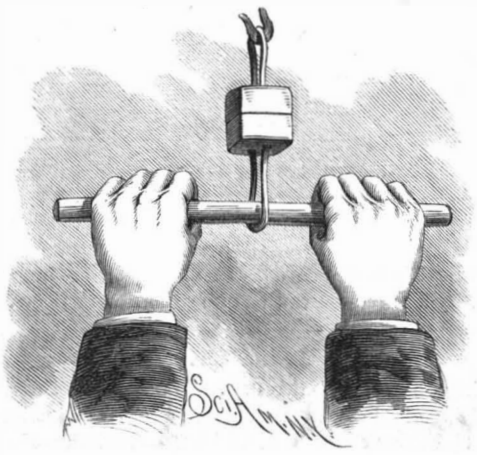
Early in 1886, Prof. Holden made contracts with the



JAMES LICK.

Southern Pacific and other railroad companies for supplying time from the observatory by automatic electric signals. This regular time service, of which Mr. Keeler has charge, has been in operation since January, 1887. A great part of the apparatus used in this service forms an integral part of the observatory's equipment. The system which has thus been introduced has been of great service to that particular section of the country, as well as to the railroad companies.

Instruments for recording earthquake shocks have been constructed by a company in San Francisco, and are sold at a very low figure. It is designed in this way that records of any seismic movements shall be procured by private individuals in different parts of the



COHESION—BLOCKS SUSTAINING DIRECT STRAIN.

State, and plates upon which the movement has been recorded may be sent to the observatory, where a record will be kept of all such data, and blue prints will be made of the diagrams and copies of this sent to the person from whom the plate has been obtained. Although this is quite independent of the regular work of the observatory, it will doubtless lead to the accumulation of data which will be most important in formulating statistics for future use.

The great telescope has been mounted for several weeks, and several satisfactory tests of its capacity have been made. It was first directed to the sky on the evening of January 3, 1888, and a few observations were then made for the partial adjustment of the object glass, but the observation was abbreviated by the skies becoming cloudy. The next observations made were on the evening of the 7th. On this occasion Saturn was observed, and Mr. Keeler, who conducted the observation, says with rapture that it was "the most glorious telescopic spectacle ever beheld." He exclaims: "Not only was he shining with the brilliancy due to the great size of the objective, but the minutest details of his surface were visible with wonderful distinctness."

The outlines of the rings were very sharply defined. The most curious feature was the structure of the outer ring; at about one-fifth of its width from its outer edge, a fine dark line was discernible, which marked the beginning of the dark shading, diminishing in intensity up to the black line. The inner ring did not shade off gradually into the gauge ring, as often represented, but the line of separation was distinct. The space between its inner edge and the planet was perfectly black.

Much of the data given in this article was procured from Prof. Holden's report in the *Sidereal Messenger* and Mr. James E. Keeler's notes on his own observations in the same journal. The observatory with its apparatus and appurtenances is to be transferred, upon its completion, to the University of California, and will in future be under the government of the regents of that institution. Prof. Holden resigned the presidency of the University in order to become director of the observatory.

COHESION OF LEAD.

T. O'CONOR SLOANE, PH.D.

It has long been known that perfectly clean surfaces of lead, when pressed together, would adhere to each other with some force. The experiment ranks as one of the classics in simple science. A very good way to show it is with bullets. Small surfaces, flat and clean, are prepared on two bullets by cutting off a little slice with a knife. When pressed together with a wrenching motion, the two will remain attached. A third bullet may now be fastened to one of the pair, and in this way a string of bullets, six or more in length, can be built up.

As the phenomenon depends on the absolute cleanness of the surfaces, and as it is a case of adherence of like to like, it is often invoked as an illustration of cohesion. Pure India rubber shows the same tendency, but in a far stronger degree relatively speaking. Whether it is true cohesion or not is uncertain, especially in the case of lead.

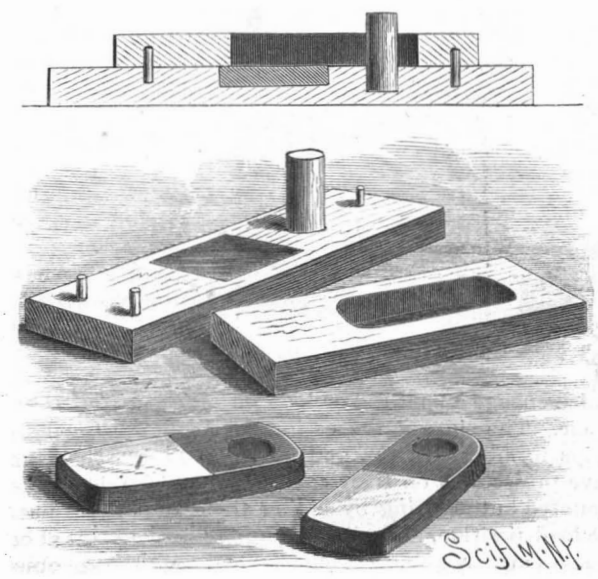
The method of obtaining this cohesion by employing mechanically prepared surfaces is a far less attractive method than the one which Faraday used in his lectures. He melted the lead and poured it out in two pieces upon a flat stone. After they had cooled, he pressed together the smooth lower surfaces of the lead, and thus obtained strong attachment. The flat plane on which the lead rested gave the essential true surface, while during the cooling it was perfectly protected from oxidation or dust. When lead is thus treated, even the upper surfaces which have been exposed to the air will answer for the experiment.

To make the phenomenon really impressive, it may be carried out on a larger scale. In the illustrations the necessary apparatus for conveniently doing this is shown. As mould for the face of the lead a polished block of metal is used. All things considered, this appears to work better than marble, which is the most available stone surface. A block of steel answers very well, and with use becomes slightly colored, as if by formation of magnetic oxide, and resists the rusting action of the atmosphere very well.

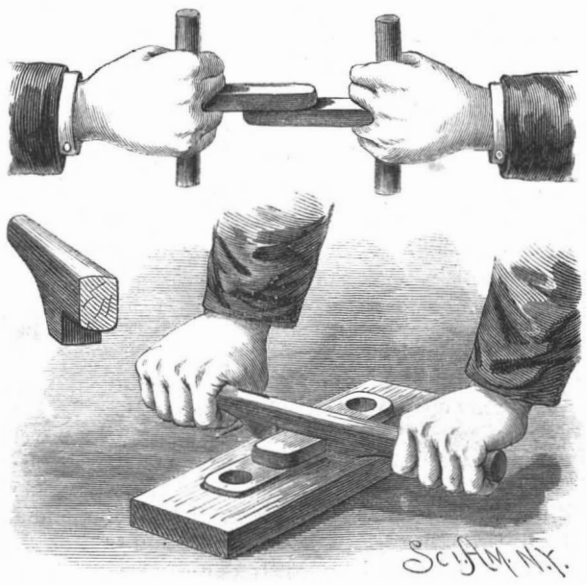
The metal block is set into a wooden base, so as to lie with its face even with the surface of the wood. Through a second piece of wood an oblong hole is cut. This should be about twice as long as it is wide. Its width should be equal to that of the metal block, or a shade less. When this is placed upon the base piece, so that the metal block lies at one of its ends and within the opening, the body of a mould is formed. Toward one end a round pin of wood is inserted. If lead is poured into the mould, it will assume an oblong form. Near one end will be a hole, and a face more or less smooth will be formed at its other end.

As regards size, a metallic block 1¼ inches square will answer for the face. The cavity of the mould should be about twice this length. A depth of from one-half to three-quarters of an inch is ample. The lead is melted and poured into the mould. As soon as solid the mould may be taken to pieces, the lead placed to one side to cool, and a second piece cast. This gives two corresponding pieces of lead.

Another piece of wood is provided, which contains a



LEAD COHESION BLOCKS—THE MOULD.



COHESION—RUBBING BLOCKS TOGETHER.

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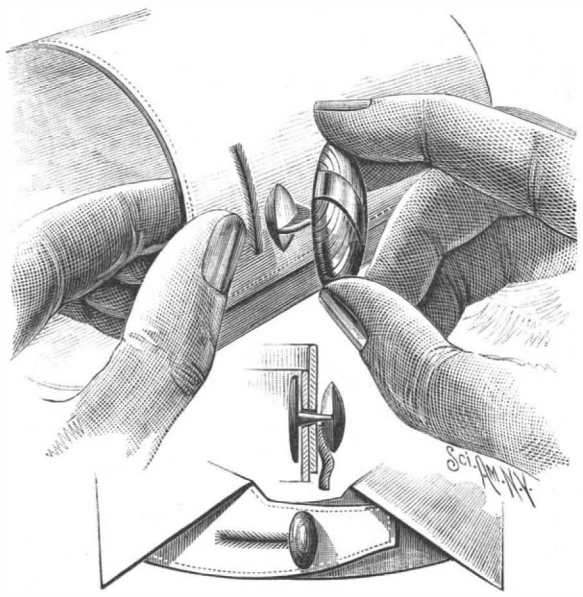
shallow mortise or groove adapted to receive one of the pieces for nearly its full depth. A cross bar, with a piece cut out transversely, so as to form a notch 1¼ inches wide in the present case, is also necessary. Within the notch the wood is best rounded off. One of the pieces of lead is placed in the shallow mortise, with the smooth face uppermost. The other is placed upon



BENEDICT'S COLLAR OR CUFF BUTTON OR STUD.

it, but smooth face downward, the two clean surfaces of lead being in contact. By means of the cross bar the upper block of lead is pressed down with the full weight of the experimenter, and at the same time two or three slight twists or wrenches are given. The notch enables this to be done effectively. The latter wrenching movements are quite essential. In extent they may cover an angle of ten degrees.

The two pieces will now cohere or adhere strongly to each other. If all is properly done, they will resist a fair pull of one hundred and fifty pounds. A very slight transverse strain will immediately separate them. When pulled apart a slight roughness characterizes the points of attachment. The object of the holes is to supply places for the insertion of handles or cross bars, with which to pull them. If the experimenter is not too heavy, he can hang with his full weight suspended from them.

The stress here produced is analogous to shearing. To obtain the direct strain, two square blocks are cast upon the same metallic face, a differently shaped upper mould being used. This only requires one extra piece of board. Two square blocks of lead are made by the same process in general, and in each case a wire loop is inserted while the lead is yet soft. By using the notched bar and slotted block these are pressed together. A hole has to be made in the center of the slot for the loop of the bottom piece to pass through, and the cross bar can be passed through the loop of the upper piece.

They are pressed and twisted, as already described, and adhere about as strongly or nearly so as the others. From a pair of such pieces, 1¼ inches square, a weight of 103 pounds was suspended.

A DEVICE FOR UNLOADING AND STACKING HAY.

An invention providing means by which hay may be readily unloaded and formed in a stack is represented in the accompanying illustration, and has been patent-

HOYT'S HAY UNLOADER AND STACKER.

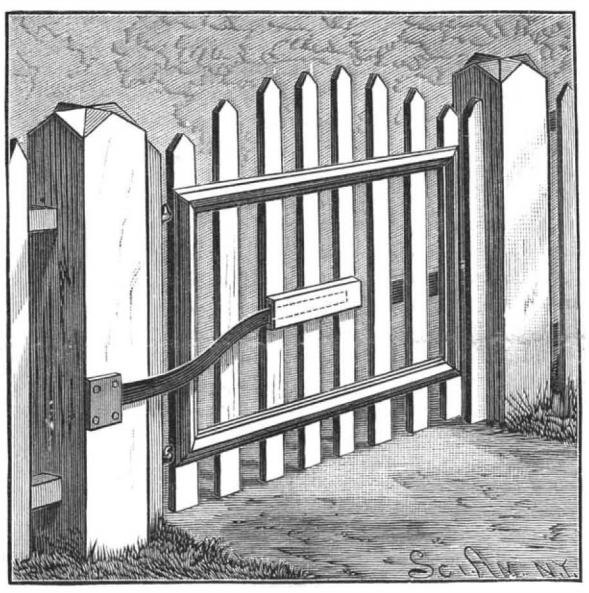
ed by Mr. Ovando Hoyt, of Ovando, Deer Lodge County, Montana Ter. The device consists of a novel construction of rack, to be placed near the spot selected for the stack, and used in connection with a pole held in perpendicular position, carrying pulleys and a hoist rope, to be drawn upon by a team of horses. The slings to be used in the wagon consist of lines secured at their outer ends to poles, which hang longitudinally over the basket sides of the wagon as it is being loaded, and the pole next the rack is provided with short chains, which are to be hooked over pins on the opposite side of the rack when the load is to be lifted. This invention is designed to facilitate the handling of a large quantity of hay at one time, without much strain upon the team, as the load is rolled from the wagon upon the slatted table of the rack, and from thence deposited on the ground or stack, the slats on one side of the rack preventing the hay from scattering beneath.

AN IMPROVED COLLAR OR CUFF BUTTON.

A special form of collar or cuff button or stud, designed to facilitate its insertion into and removal from the button hole, has been patented by Mr. Read Benedict, and is shown in the accompanying illustration. The shank is made flat upon two sides, to permit the button hole to close under the head of the button, the flat surfaces being brought parallel with the edges of the button hole, and the lower surfaces of the head of the button are curved or beveled from the flat surfaces of the shank upward to facilitate the passage of the head out of the button hole. For further particulars with reference to this invention address Messrs. Benedict Brothers, 171 Broadway, New York City.

AN IMPROVED GATE SPRING.

A gate or door spring which is easily applied and effective in operation is illustrated herewith, and has been patented by Mr. Theodore Clough, of Dobbs Ferry, N. Y. To the face of the gate is secured a housing in which there is fitted to slide the end of a plate spring, the other end of the spring being rigidly connected to the post by a plate, the arrangement being such that when the gate is swung back the spring will be drawn out of its normal position, its outer end sliding



CLOUGH'S GATE SPRING.

somewhat in the housing, and when the pressure upon the gate is relaxed the spring will act to return it to its normal position, the throw of the gate in closing being limited by a stop secured to one of the gate posts.

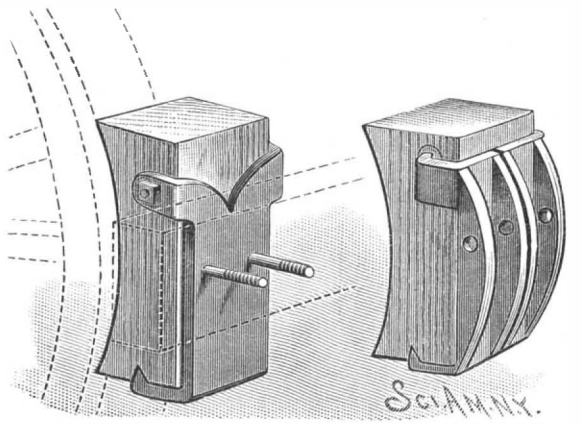
Apantlesis.

Having observed that on several occasions the upper part of an alcohol thermometer column, after having slowly risen from a considerable contraction, was colorless, and that no deposit of the coloring matter (probably cochineal) had taken place, Mallet was led to make further experiments in this direction. It seemed as if the colorless alcohol had by its expansion separated itself from a still perfect solution left behind. The solutions used were partly aqueous, partly alcoholic, of several colloid substances, starch, tannin, caramel, albumen, and gelatin. Each solution was placed in a flask of about half a liter capacity, surrounded with ice, the mouth of the flask being closed with a cork carrying a glass tube about 4 mm. in diameter and 15 or 20 cm. long, having a glass tap near its middle point.

The ice being removed, the liquid was allowed to rise in temperature until the column, originally a centimeter or two below the tap, was as much above it. The tap was now closed and the liquid above it submitted to examination in comparison with an equal volume of the original solution. In all cases the liquid above the tap contained a less amount of material in solution, in some cases very notably less; while in two or three cases there was practically none. As all the solutions were carefully filtered at the outset, there could have been no settling of particles. The conditions influencing the result seem to be: First, the proportion of the colloid solid in solution; and second, the time occupied in the rise of temperature. The author has given the name *apantlesis* to this phenomenon, signifying a draining away of some of the molecules of the solvent from those of the colloid while the solution was undergoing expansion.—*Chem. News.*

AN IMPROVED BRAKE BLOCK FOR VEHICLES.

An invention providing means whereby a brake shoe for vehicles can be easily and quickly removed when worn out, and a new one inserted, is illustrated herewith, and has been patented by Mr. George A. Posson, of Angwin, Napa County, Cal. The brake shoe may be of rubber, wood, or other suitable material, and has a metallic back formed with upper side flanges, embracing the sides of the block, and a bottom flange having upward-projecting points entering the lower end of the shoe, bolts projecting from the rear face by which the brake block is secured to the brake bar. For buggies and spring wagons, as well as for farm wagons, a modified construction is shown in the figure to the right, in which the metallic back is made in two halves, each half having ribs fitted to the brake bar, and with apertures through which passes a bolt for holding the halves on the brake shoe and the brake block on the brake bar, the upper flanges in this case having side projections passing into apertures in the sides of the brake shoe.



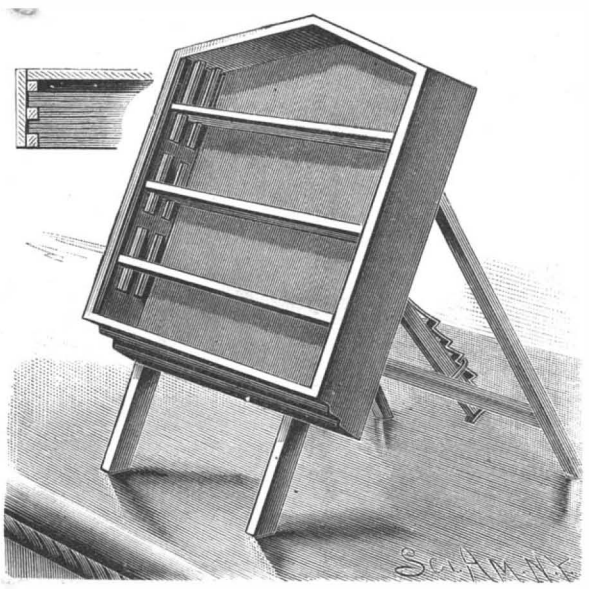
POSSON'S BRAKE BLOCK.

An Ingenious Experiment.

Herr J. Puling, of Vienna, has devised an ingenious method of rendering visible the form of a stretched string set in vibration by having one of its extremities attached to one prong of a tuning fork, which was kept in motion electrically, and gave a definite note, the pitch of which was carefully determined. The vibrating string was lighted up by a vacuum tube connected with a Ruhmkorff coil, the rate of discharge through the tube being alterable at will, and when this is made equal to or some aliquot multiple of the number of vibrations made by the string, the latter was only illumined when occupying some one definite position, and owing to the persistence of its image on the retina, appeared as if at rest. In this way the shape of the string and the positions of the modes and vertical segments were rendered clearly visible.

AN IMPROVED STAND FOR DISPLAYING GOODS.

A frame or open casing containing removable adjustable shelves and an adjustable and folding brace support, making a stand designed to be mounted on a counter or in other suitable position for conveniently displaying goods, is illustrated herewith, and has been patented by Mr. Ralph H. Maxson, of Richburg, N. Y. The frame is adjustably held in open position by a brace bar pivoted to a strip on the back, and having a spring catch at its free end formed with shoulders



MAXSON'S STAND FOR DISPLAYING GOODS.

which engage a bent rod or loop on a cross bar of the frame. The sides of the casing are made with short strips forming grooves and spaces, and the shelves have projections on their ends whereby they may be mounted in the casing by sliding them to place in an inclined position, and sliding the projections in the grooves until a space is reached, when the shelves may be slid back in a horizontal position.

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SIMPLE ELECTRIC MOTOR.

BY GEO. M. HOPKINS.

It is generally understood that an efficient electric motor cannot be made without the use of machinery and fine tools. It is also believed that the expense of patterns, castings, and materials of various kinds required in the construction of a good electric motor is considerable. The little motor shown in the engravings was devised and constructed with a view to assisting amateurs and beginners in electricity to make a motor which might be driven to advantage by a current derived from a battery, and which would have sufficient power to operate an ordinary foot lathe or any light machinery requiring not over one man power.

The only machine work required in the construction of the motor illustrated is the turning of the wooden support for the armature ring. The materials cost less than four dollars, and the labor is not great, although some of the operations, such as winding the armature and field magnet, require some time and considerable patience. On the whole, however, it is a very easy machine to make, and if carefully constructed will certainly give satisfaction.

Only such materials as may be procured anywhere are required. No patterns or castings are needed.

Beginning with the armature, a wooden spool, A (Fig. 2), should be made of sufficient size to receive the soft iron wire of which the core of the armature is formed. The wire, before winding, should be varnished with shellac and allowed to dry, and the surface of the spool on which the wire is wound should be covered with paper to prevent the sticking of the varnish when the wire is heated, as will presently be described. The wire is cut off and the ends (about two inches in length) are twisted together to cause the coil to retain its shape. After the completion of the first section, one of the pieces, C, is moved to a new position

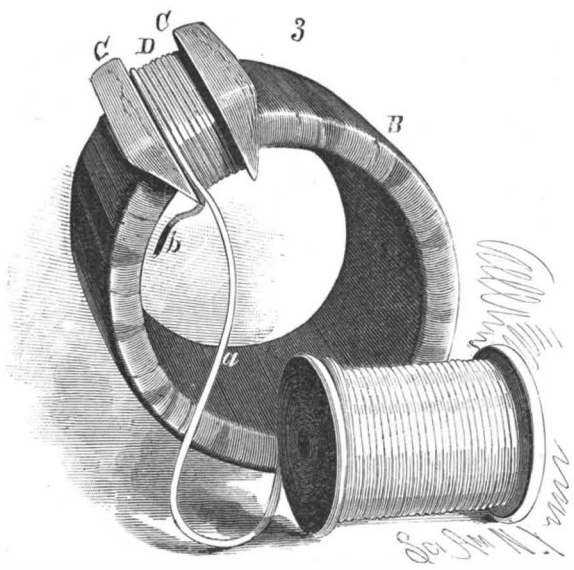


Fig. 3.—WINDING THE ARMATURE.

and the second section is proceeded with, and so on until the twelve sections are wound. The coils of the ring are then varnished with thin shellac varnish, the varnish being allowed to soak into the interior of the coils. Finally the ring is allowed to remain in a warm place until the varnish is thoroughly dry and hard.

Care should be taken to wind all of the coils in the same direction and to have the same number of convolutions in each coil. A convenient way of carrying the wire through and around the ring is to wind upon a small ordinary spool enough wire for a single section, using the spool as a shuttle.

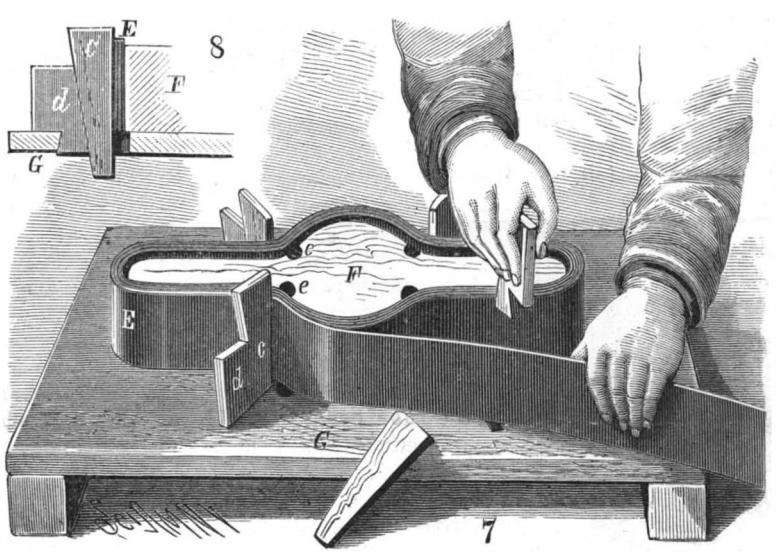
The ring is mounted upon a wood support or hub, G, and is held in place by the wooden collar, H, both hub and collar being provided with a concave flange for receiving the inner edges of the ring. The collar, H, is fastened to the end of the hub, G, by ordinary brass wood screws. Both hub and collar are mounted on a $\frac{9}{32}$ steel shaft formed of Stubs' wire, which needs no turning. A pulley is formed integrally with the collar, H. The end of the hub, G, which is provided with a flange, is prolonged to form the commutator, and the terminals, *a b*, of the ring coils are arranged along the surface of the hub and inserted in radial holes drilled in the hub in pairs. The wires are arranged so that one hole of each pair receives the outer end of one coil and the other hole receives the inner end of the next coil, the extremities of the wire being scraped before insertion in the holes. The distance between the holes of each pair is sufficient to allow a brass wood screw to enter the end of the hub, G, and form an electrical contact with both wires of the pair, as shown in Fig. 4.

There being twelve armature sections and twelve pairs of terminals, there will of course be required a corresponding number of brass screws. These screws are inserted in the end of the hub, G, so as to come exactly even with the end of the hub. This completes the armature and the commutator.

Before proceeding to mount the armature shaft in journal boxes, it will be necessary to construct the field magnet, as the machine must, to some extent at least, be made by "rule of thumb."

The body, E, of the field magnet consists of strips of Russia iron, such as is used in the manufacture of stoves and stove pipe. The strips are 2½ inches wide, their combined length being sufficient to build up a magnet core seven-sixteenths inch thick, of the form shown. The motor illustrated has 15 layers of iron in the magnet, each requiring about 26 inches of iron, approximately 33 feet altogether.

The wooden block, F, on which the magnet is formed



Figs. 7 & 8.—FORMING THE FIELD MAGNET.

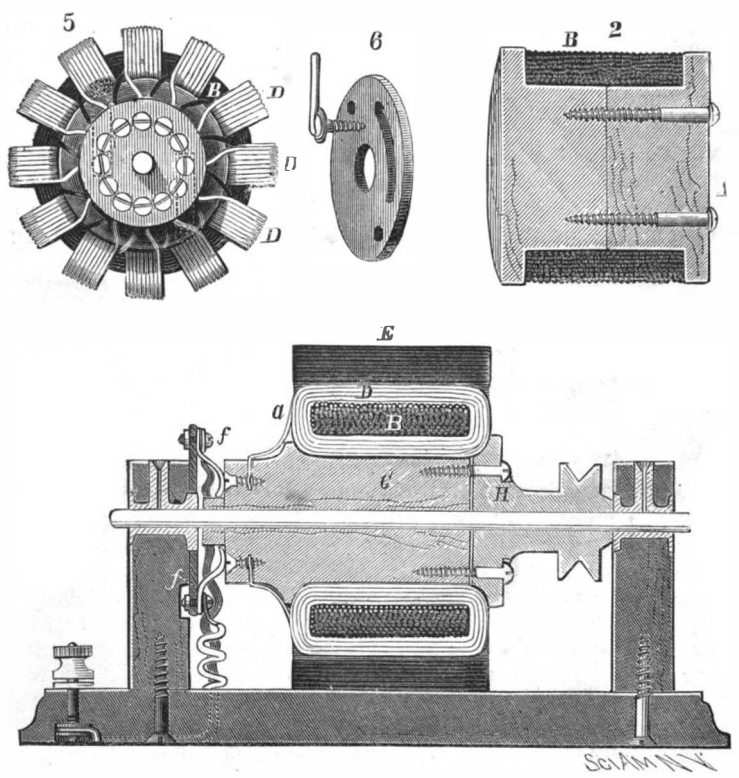


Fig. 2.—ARMATURE CORE. Fig. 4.—TRANSVERSE SECTION. Fig. 5.—END VIEW OF ARMATURE, SHOWING COMMUTATOR. Fig. 6.—BRUSH-HOLDING DISK.

size of the iron wire is No. 18 American wire gauge. The spool is $2\frac{3}{16}$ inches in diameter in the smaller part and 2 inches in length between the flanges. It is divided at the center and fastened together by screws. Each part is tapered slightly to facilitate its removal from the wire ring. The wire is wound on the spool to a depth of ⅜ inch. It should be wound in even layers, and when the winding is complete the spool and its contents should be placed in a hot oven and allowed to remain until the shellac melts and the convolutions of wire are cemented together. After cooling, the iron wire ring, B, is withdrawn from the spool, and covered with a single thickness of adhesive tape, to insure insulation.

The ring is now spaced off into twelve equal divisions, and lines are drawn around the ring transversely, dividing it into twelve equal segments, as shown in Fig. 3. Two wedge-shaped pieces, C, of hard wood are notched and fitted to the ring so as to inclose a space in which to wind the coil. This coil consists of No. 16 cotton-covered copper magnet wire, four layers deep, each layer having eight convolutions. The end, *a*, and the beginning, *b*, of the winding terminate on the same side of the coil. The last layer of wire should be wound over two or three strands of shoe thread, which should be tied after the coil is complete, thus binding the wires together. When the first section of the winding is finished, the

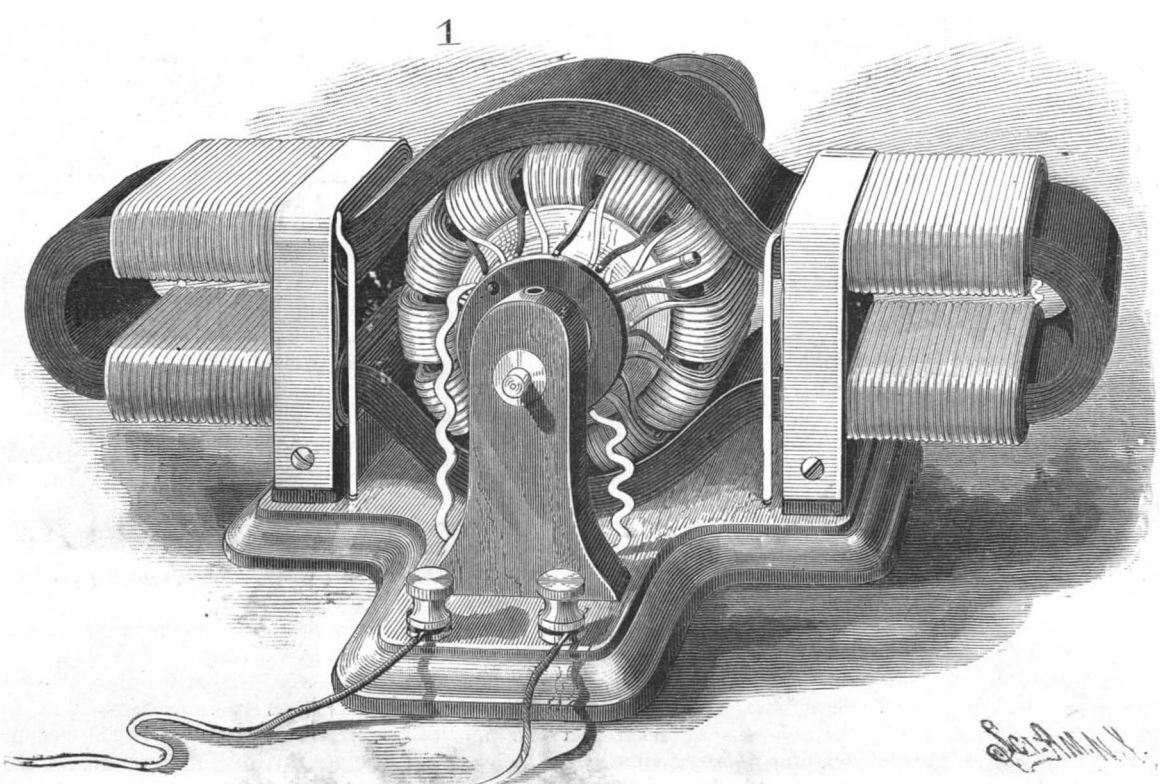


Fig. 1.—SIMPLE ELECTRIC MOTOR (ABOUT HALF SIZE).

is secured to a base board, G, as shown in Fig. 7, and grooves are made in the edges of the block, and corresponding holes are formed in the base to receive wires for temporarily binding the iron strips together. Opposite each angle of the block, F, mortises are made in the base board, G, to receive the keys, *d*, and wedges, *c*. Each key, *d*, is retained in its mortise by a dovetail as shown in Fig. 8. By this arrangement, each layer of the strip of iron may be held in position, as the formation of the magnet proceeds, the several keys, *d*, and wedges, *c*, being removed and replaced in succession as the iron strip is carried around the block, F. When the magnet has reached the required thickness, the wedges, *c*, are forced down so as to hold the iron firmly, then the layers of iron are closely bound together by iron binding wire wound around the magnet thro' the grooves, *e*, and holes in the base board, G.

The next step in the construction of the machine is the winding of the field magnet. To insure the insulation of the magnet wire from the iron core of the magnet, the latter is

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covered upon the parts to be wound by adhesive tape or by cotton cloth attached by means of shellac varnish.

The direction of winding is clearly shown in Fig. 9. Five layers of No. 16 magnet wire are wound upon each section of the magnet, the winding of sections 1 and 2 being oppositely arranged with respect to each other. In like manner the winding sections 3 and 4 are oppositely arranged. The winding of section 1 is also opposite to that of 3, and that of 2 is opposite to that of 4. The winding begins at the outer end of the magnet, and ends at the inner end of the section. When the winding is completed, the temporary binding is removed. The outer ends of 1 and 2 are connected together, and the outer ends of 3 and 4 are connected. The inner ends of 2 and 4 are connected. The inner end of 3 is to be connected with the commutator brush, *f*. The inner end of 1 is to be connected with the binding post *g'*, and the binding post, *g*, is to be connected with the commutator brush, *f'*.

The field magnet is now placed upon a base having blocks of suitable height to support it in a horizontal position. A block is placed between the coils to prevent the top of the magnet from drawing down upon the armature, and the magnet is secured in place by brass straps, as shown in Fig. 1.

The armature is wrapped with three or four thicknesses of heavy paper, and inserted in the wider part of the field magnet, the paper serving to center the armature in the magnet. The armature shaft is leveled, and arranged at right angles with the field magnet. The posts in which the armature shaft is journaled are bored transversely larger than the shaft, and a hole is bored from the top downward, so as to communicate with the transverse hole. To prevent the binding of the journal boxes, the exposed ends of armature shaft are covered with a thin wash of pure clay and allowed to dry. The posts are secured to the base, with the ends of the armature shaft received in the transverse holes. Washers of pasteboard are placed upon the shaft on opposite sides of the posts, to confine the melted metal, which is to form the journal boxes. Babbitt metal, or, in its absence, type metal, is melted and poured into the space around the shaft through the vertical hole in the post. The journal boxes thus formed are each provided with an oil hole, extending from the top of the post downward. If, after cleaning

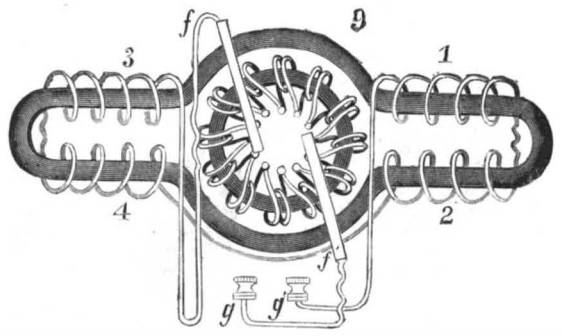

Fig. 9.—CIRCUIT OF SIMPLE ELECTRIC MOTOR.

and oiling the boxes, the shaft does not turn freely, the boxes should be reamed or scraped until the desired freedom is secured.

All that is now required to complete the motor is the commutator brushes, *f f*. They each consist of three or four strips of thin hard rolled copper curved as shown in Fig. 4, to cause them to bear upon the screws in the end of the hub, G. The brushes are secured by small bolts to a disk of vulcanized fiber, or vulcanite, at diametrically opposite points, as shown in dotted lines in Fig. 5, and the brushes are arranged in the direction of the rotation of the armature. In the brush-carrying disk is formed a curved slot for receiving a screw, shown in Fig. 6, which passes through the slot into the post and serves to bind the disk in any position. The disk is mounted on a boss projecting from the inner side of the post concentric with the armature shaft. The brushes are connected up by means of flexible cord as shown in Figs. 1 and 9. The most favorable position for the brushes may soon be found after applying the current to the motor. The ends of both brushes will lie approximately in the same horizontal plane. When the motor is in operation the direction of the current in the conductor of the field magnet is such as to produce consequent poles above and below the armature.

Eight cells of plunging bichromate battery, each having one zinc plate 5 × 7 inches, and two carbon plates of the same size, will develop sufficient power in the motor to run an ordinary foot lathe or two or three sewing machines.

The dimensions of the parts of the motor are tabulated below:

Length of field magnet (inside)	10½ in.
Internal diameter of polar section of magnet	3⅝ "
Width of magnet core	2½ "
No. of layers of wire to each coil of magnet	5
No. of convolutions in each layer	34
Length of wire in each coil (approximate)	95 feet.
Size of wire, Am. W. G.	No. 16
Outside diameter of armature	3½ in.
Inside diameter of armature core	2 3/16 "
Thickness " " "	⅜ "
Width " " "	2 "
" " " wound	2⅛ "
No. of coils on armature	12
No. of layers in each coil	4
No. of convolutions in each layer	8
Length of wire in each armature coil (approximate)	30 feet.
Size of wire on armature, Am. W. G	No. 16
Length of armature shaft	7¼ in.
Diameter of armature shaft	3/8 "
" " wooden hub	1¾ "
Distance between standards	5⅛ "
Total weight of wire in armature and field magnet	6 lb.

THE LOCKS OF THE PANAMA CANAL.

We illustrate herewith the new system of locks devised by Mr. Eiffel for use on the Panama canal.

The gates (Figs. 1 and 2) consist essentially of a hollow, balanced, movable caisson, capable of sliding above at right angles with the axis of the canal, on a track carried above the canal by a revolving bridge. This track is prolonged above the lateral chamber. The motion is analogous to that of the doors which slide at the top that are generally used in locomotive shops. When the flood gate is placed in the chamber,

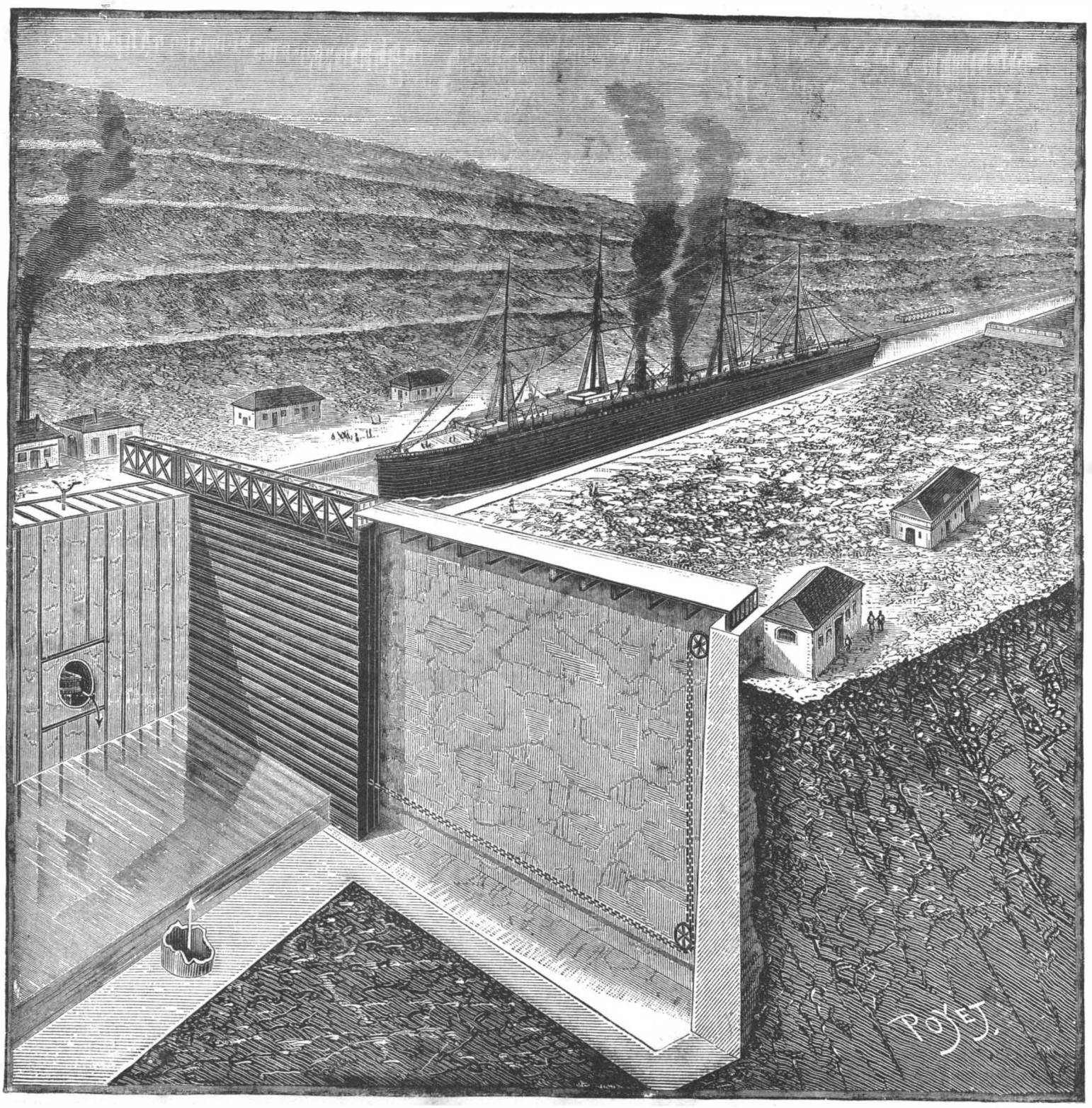

Fig. 1. LOCKS OF THE PANAMA CANAL FLOOD GATE OF 11 METERS FALL.

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it is only necessary to revolve the bridge 90° to free the passage and allow boats to go through.

The diagram in Fig. 3 shows the maneuver. A vessel, S, is about to pass from lock, B B′, to the reach, C. To this effect, at N the gate, P′, taken from its chamber, R, bars the canal, and the bridge, A′, is closed above it. At M the gate, P, has slid into its chamber, R′. The revolving bridge has pivoted 90°, and opened the passage.

The gate or movable caisson, the sides of which are stiffened from meter to meter by strong, horizontal, T shaped iron beams, which carry all the stress of the water pressure over to the side walls, is arranged beneath like the working chambers of the caissons used in constructing bridge piers. Moreover, above the working chamber, it is divided into nine compartments by three horizontal and three vertical partitions. All these compartments, as well as the bottom chamber, communicate with the external air through chimneys starting from air locks, so that either water or compressed air may be allowed to enter them at will. Owing to this arrangement, it is easy to balance and ballast the gate, and, besides, on exhausting its different parts in succession, to inspect and repair them. The gate is suspended from a carriage provided with rollers, which, on rolling over the track carried partly by the bridge and partly by a framework, carries along the gate.

The suspension rods of the gate are not fixed in an invariable manner to the carriage. They carry rollers at their upper extremities which are capable of revolving to a certain distance upon transverse rails fixed to the carriage. The object of this arrangement is to start the gate before sliding it forward and to prevent its rubbing against the walls of the chamber and its bearing points. The gate remains constantly suspended by parts situated outside of the water, and which can be repaired and kept in order with the utmost ease. This mode of suspension offers the advantage that it assures the complete stability of the gate, even under the influence of winds that might be capable of overturning it. For a lock of 11 meters fall the dimensions are as follows:

TAIL GATE.

Height	21	meters.
Width	4	"
Length	21·6	"

HEAD GATE.

Height	10	meters.
Width	3	"
Length	21·6	"

For the lock of 8 meters fall, the height alone varies. The section of the canal left free by the opening of the gate is 18·6 meters at the lower part and 20·6 at the leveling of the talus and works of access. The location for the locks will have to be so selected that they can be excavated in compact rock. The side walls of the intermediate locks will then consist of the rock itself, with a thin lining in places where there are cracks. As for the side walls of the heads, they will be formed of T-iron caissons lined with cast iron and filled in with beton. Their dimensions vary with those of the locks. For a lock of 11 meters fall they are as follows:

Thickness	5·5	meters.
Height	24·25	"
Length	30	"

The revolving bridges are of iron or steel, and are 5·5 meters in width by 34·2 in length. This length is divided into two sections of 23·8 and 10·4 meters on each side of the axis of revolution.

The gate chambers are 7 meters in width by 30 in length. The maneuvering of the bridges and gates is effected through chains winding around capstans actuated by hydraulic power, through turbines moved by the fall of water occasioned by the reaches.

In order to introduce so great a mass of water in so short a time (40,000 cubic meters in 15 minutes), it has been necessary to adopt peculiar arrangements. The method adopted consists in making the water flow through the entire length of the lock and in vertical jets, so as to prevent the strong eddies and tumultuous motions that would necessarily be produced in this arrangement. To this effect, for the entire length of the lock, and laterally, in channels beneath the flow of the canal, there run two large cast iron pipes, 2·8 meters in diameter, provided at every 2 meters distance with 0·40 meter apertures. These pipes pass beneath the sill of the gates, at each extremity, and are prolonged about 15 meters down stream and about 12 up stream in the reach that follows the lock (Fig. 4). Here they curve, and, at 9·75 meters above the floor, terminate in a valve contained in a chamber formed in the side wall. There are, then, two valves of this kind to each reach. These valves, due to Engineer Fontaine, are cylindrical, and without lateral pressure, thus rendering the maneuvering of them extremely easy. With this system the emptying and filling of the locks will take but a quarter of an hour.

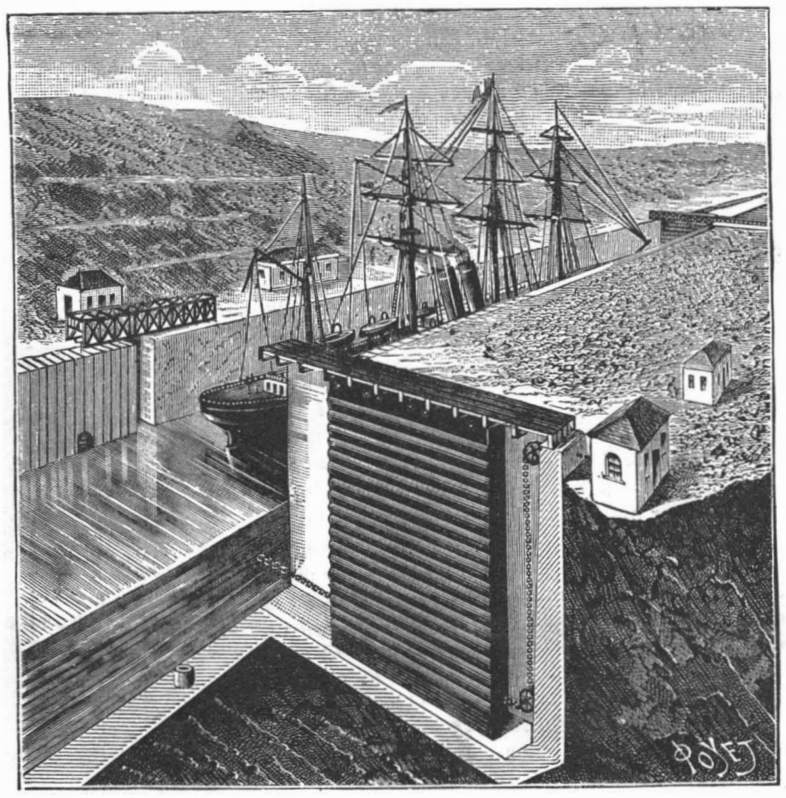

Fig. 2.—THE GATE OPEN.

For the illustrations and description of these gates, we are indebted to *Le Genie Civil.*

New Photo-Stereotype Printing Process.

A new process of so-called autostereotypic printing, especially adapted for the reproduction of books and engravings, has lately been invented in Switzerland, and is already used with advantage at the establishment of Orell, Fussli & Co., at Zurich, a printing office of European fame. The process will cheapen the reprinting of the works of foreign authors. By this method the type setting and the copying of engravings is saved and an accurate stereotyped plate is obtained directly from the original. It is a transfer process, and for the reproduction two newly printed copies of the publication to be reproduced are necessary to insure complete sucess. It is done in the following manner: Plaster of Paris, best quality, is mixed with water to make it a thin putty without lumps, and to this a little alum or salt is added to make it set quickly. To every 5 lb. of the plaster are then added: Silicate of potash or silicate of soda, 3 oz.; phosphate of lime, 2 oz. The mixture thus obtained is then put upon a perfectly level piece of plate glass of the desired size, around which iron rods are placed, and left to get hard. The plaster cast ought to be at least type high, to prevent breakage. While the mass is setting, the back ought to be scraped level, and should remain undisturbed until it is perfectly dry and hard. After that it may be taken off, and it will be found to be as smooth as the glass itself.

The paper to be reproduced is next placed, with the side to be copied down, in a dish which contains the following transferring solution: Distilled water, 16 oz.; alcohol, 90°, 5 oz.; acetic acid, ¼ oz.; phosphate of soda, ¼ oz. Care should be taken not to get the solution on the back of the paper, which is not to be transferred, as it is then liable to print through when it is drawn through the transferring press. Should the print to be copied have been printed for some time, it is desirable to warm the solution and float the paper longer on it. The sheets should be left on the solution for at least two hours to insure perfect action. In the mean time, the plaster of Paris plate, which was completely dried before, is prepared in a dark room. A solution of 5 oz. of gelatine in 12 oz. of water is prepared by letting the former soak for half an hour and then heating it to about 190°. Care must be taken to prevent the boiling of the solution. To this six drachms of citrate of iron and ammonia and 2 oz. of alcohol are added and well filtered. This is when still warm. Put into a flat dish covered to a depth of about ¼ in. It is well to put this dish upon a hot metal plate, as it gets hard quickly when getting cold. The plaster of Paris plate, which itself is warmed first, is dipped in the solution on the smooth side for a moment, thus letting it take up some of it, whereupon it is taken out and dried in the dark. When dry, the copy is transferred upon it in the usual way, the plaster having been placed between rubber sheets to prevent it from breaking. Of course, also, this has to be done in the dark room, that is, at lamp or gas light. The plate is then dried once more and exposed to direct sunlight for fifteen minutes. When taken out, the places where the light has acted will be found to be quite hard, while at the other places the plaster is soft, and will fall off as fine powder as deep as the solution has penetrated, if brushed with a hard brush. After that the plate is ready to be stereotyped.

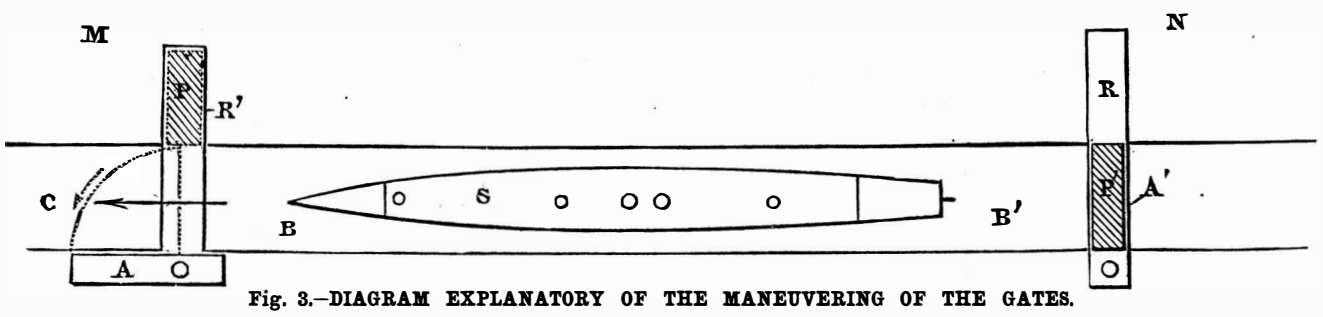

Fig. 3.—DIAGRAM EXPLANATORY OF THE MANEUVERING OF THE GATES.

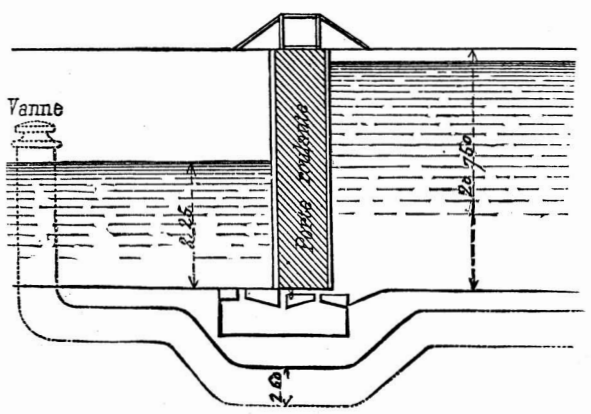

Fig. 4.—POSITION OF THE PIPES FOR FILLING THE LOCKS.

The Condition of Sulphur in Vegetation.

The conditions under which sulphur appears in coal are to some extent elucidated by recent experiments of MM. Berthelot and Andre upon the forms in which sulphur may be found in plants. These experimentalists state, in a communication to the *Comptes Rendus*, that sulphur occurs in plants as sulphates. In the form of ethereal compounds comparable to the ethyl-sulphates and glyceri-sulphates capable of being split up by hydration under the prolonged action of dilute acids or alkalies, or by oxidation. In the form of mineral compounds, such as sulphides, sulphites, hypo-sulphites, etc., convertible by the moist way into sulphates by the prolonged action of oxidizing agents. In the shape of organic compounds, such as taurine, cystine, the sulpho-conjugated acid and albumen compounds, the sulphur in which is not convertible into sulphuric acid in the moist way. The sulphur of plants has been determined by the authors, with absolute accuracy, by burning the sample (previously dried at 100° C.) in a column of oxygen, passing the resultant vapors through a long column of pure anhydrous sodium carbonate. The tube is of hard glass, and the temperature is near redness.

When the organic product is entirely burnt, the current of oxygen is still maintained for some time, so as to complete the conversion of any sulphureted salts into sulphates. After this is effected, the tube is allowed to cool, the contents are dissolved in water acidulated with hydrochloric acid; then boiled; and the sulphuric acid precipitated in the ordinary manner. MM. Berthelot and Andre do not appear to have experimented on fossil plants.

Sheep Bugs.

There are many breeders and sheep raisers in Delaware County, N. Y., and in years past they have had to cope with a variety of diseases among their flocks. At the present time sheep are suffering from the ravages of bugs, and there seems to be no potent remedy at hand to kill them. The pests measure from one-half to three-quarters of an inch in length, and look more like the ordinary snapping bug than anything else. The pests burrow their way into the heads and brains of the sheep, and the loss in the aggregate incurred thereby is quite large.

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Correspondence.

The Panama Canal.

To the Editor of the Scientific American:

As our papers do not often publish anything but unfavorable information regarding the canal, it may surprise your readers to be told that on Washington's birthday there was an opening of the Gatun section, and steamers proceeded from tide water to a point beyond Gatun, a distance of 11 miles; and by the end of this month the canal will be navigable for 15 miles (to Bohio) for vessels of 1,000 tons burden.

The excavating has gone on very rapidly of late, the excavation for first half of February being 384,521 cubic meters, while the usual amount for a whole month has heretofore averaged about 332,000.

The cut for the Chagres River is well under way, some 1,800,000 cubic meters of excavation having been made on this part of the work alone.

The American Contracting and Dredging Company are pushing their part of the work very rapidly, and between January 15 and February 15 contributed over 390,000 cubic meters of excavation to the year's work.

A. P. HOWARD.

Boston, March 7, 1888.

Openings for American Trade and Enterprise in Venezuela.

To the Editor of the Scientific American:

As your valuable paper has a wide circulation among all classes, and as I have noticed that you give some prominence in your columns to what is going on in foreign parts, I have thought it would be a good idea to ask you kindly to insert the following remarks as a general answer to the many letters of inquiry with which this consulate is favored:

Every mail brings me a large correspondence, and there appears, I am glad to say, a tendency on the part of our people to make a peaceable commercial and industrial invasion of this part of South America.

I therefore take the liberty of intruding upon your space in order to explain in what way our countrymen may establish themselves in this section of Venezuela with but little risk of failure and a fair probability of success. It is a great pity that in the early days immediately after the independence of the South American states, we did not take steps to make our commercial influence paramount.

We, however, lost the opportunity, and to-day only are attempting to gain what should have been ours from the beginning.

For this reason it gives me pleasure to point out the various ways in which success may be tolerably assured to any one possessing the requisite capital and energy. For many reasons this part of Venezuela offers more inducements than any other section of the republic.

The progressive spirit of the people, the ready welcome given to foreigners, the eager desire for improvement and development, and the excellent government with which this division of the Venezuelan federation is favored make it a most promising field for enterprising and intelligent industry.

The natural resources are such that within the limits of the State of Zulia, of which Maracaibo is the capital, agriculture, mining, and stock raising can be carried on to exceptional advantage.

Commercially and industrially, Maracaibo is the most important point on the north coast of South America, and with its steady increase in population and the development of its industrial capabilities, it must some day become a busy metropolis.

I beg to give publicity through your columns to the more advantageous opportunities offered by this section, and particularly by the city of Maracaibo; and although this is intended as a general answer to numberless inquiries, yet I will gladly give further details, as far as may be in my power, to any one requesting them.

My attention has been called to the extensive business now being carried on in the United States in the matter of portable wooden houses, and I believe that Maracaibo would be a good field for their introduction.

Concessions of law for building purposes could be easily obtained from the municipal government, and should one of our manufacturing firms run up one or two blocks of the houses referred to, they could no doubt be at once advantageously rented or sold, and the business established on a good basis. This is an industry which, once introduced, would give excellent results, and is worthy of examination.

In connection with the following suggestions, it will be understood that the city would have no hesitation in giving land at a nominal price, sufficient for the necessities of any *bona-fide* industry, whose development would, moreover, be encouraged by exemption from imposts.

A first class foundry and shop for repair of machinery should pay well if managed intelligently.

A brick yard and tile factory, run by steam, and with all the modern appliances, could do a fine business. There are many kilns here, all, however, on a small scale, and the demand for their products is large and constant.

The method of manufacture is of the most primitive character, and as excellent material is abundant and close at hand, there is no reason why one of our enterprising brick makers, thoroughly posted in his business, should not make large profits from the beginning.

A manufactory of pottery, from the most ordinary grade to the finer classes of ceramic work, would find an immediate and profitable market for its products. There exist almost within the city limits the finest grades of clay, and it only needs intelligence and capital to turn out work much superior to that now imported from abroad.

A furniture, window, and sash factory would meet with ample patronage.

To me, it is a matter of surprise that no one has ever thought of establishing, on a large scale, a first class tannery in Maracaibo.

From this port are exported large quantities of hides and skins, which are here abundant, cheap, and of excellent quality. The dividivi, which is used both in this country and Europe as a substitute for bark, is found in the immediate vicinity of Maracaibo, and in such quantities as to make it an important article of export. The consumption of leather is large, the importation being great, and I can scarcely imagine a safer line of business, or one with more probability of profit, than a thoroughly first class tannery.

A boot and shoe factory with the modern mechanical appliances would pay well. All shoes are hand made, dear in price, and not of the best workmanship.

The demand is great, and various shops, some on quite a respectable scale, do a good business. Should a manufactory be opened in this city, capable of turning out good machine work at a moderate price, the results could not be other than satisfactory. I may mention incidentally that the import duty on foreign boots and shoes is excessive, amounting to four dollars per kilogramme, primary duty, and about sixty cents secondary, resulting that the entire duty is about two dollars per pound.

This practically prevents foreign competition, and aids greatly the successful prosecution of this industry in Venezuela.

A dairy on a large scale with a vegetable garden attached would be well patronized.

Vegetables are scarce and dear, there being no *truckers*, and I believe that the business, once started, would give good returns. In connection with this industry, stock raising could be engaged in. Grazing land abounds and is free to all, and breeding has always been one of the most successful pursuits in this section.

On the frontier of the Goajira peninsula, at the extreme northwest of Venezuela, the business of stock raising is being carried on to great advantage, in spite of the proximity of the famous Indians of that section, and it is calculated that with ordinary good luck, the original capital invested may be doubled in four years. In the district of Perija, to the westward of this city, there are unrivaled facilities for the breeding of cattle, as on the extensive savannas there is an abundance of grass of various classes, and no lack of water.

The great wealth of this section consists, however, principally in its mineral deposits. Asphalt, petroleum, and bituminous coal abound, and serious efforts are about to be made to utilize these valuable products. Should a petroleum refinery be established on a sufficiently extensive scale to supply the domestic demand, the profits would be great, as the crude article is practically inexhaustible.

The fisheries of this coast would also richly repay their systematic development. Many persons now make a good living at the business, and were it taken in hand in a careful and intelligent manner, its importance would be vastly increased.

The sounds of the "curbina" are largely exported for the manufacture of gelatine, and command excellent prices abroad.

A first class hotel would receive good patronage in Maracaibo, as would probably also a good restaurant *a la carte*.

With the present rapid growth of the city, and its increase in population, an additional market has become a necessity, and it may be suggested to the manufacturers of portable wooden houses, that a contract for its erection, with favorable concessions, might possibly be obtained.

The foregoing remarks are intended to point out the more prominent industrial opportunities of this district, and, as I have already stated, it will give me pleasure to answer in detail any inquiries.

You will kindly excuse this intrusion upon your space, and accept my thanks for your courtesy.

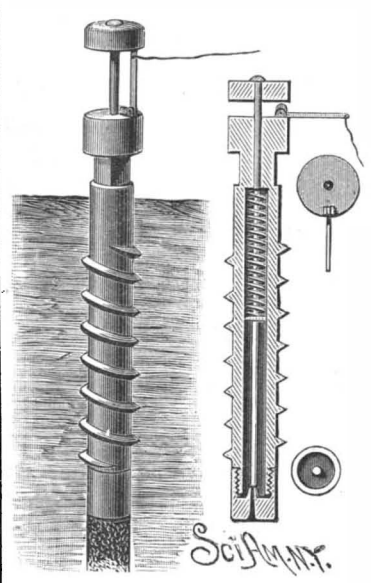
E. H. PLUMACHER, *U. S. Consul.*

United States Consulate, Maracaibo,
February 14, 1888.

LIEUT. HUNTER.—A correspondent writes us that Lieut. Hunter, one of the "fathers of the American steam navy," is still living in New Orleans, La., 85 years of age.

A DEVICE TO FACILITATE BLASTING STUMPS, LOGS, ETC.

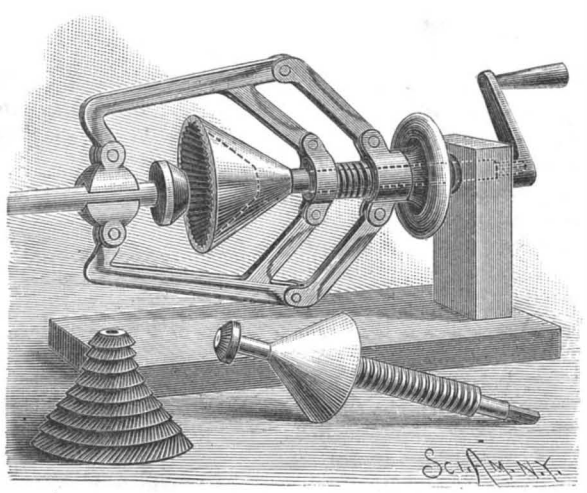
A blasting plug intended especially for use in blasting wood, by which the ordinary tamping of rocks, etc., in the drilled blasting hole may be avoided, and in which no fuse will be necessary, is shown in the accompanying illustration, and has been patented by Mr. Alfred Winder, of Washington, D. C. The plug is exteriorly threaded, to facilitate securing it in the blasting hole, and has a central bore provided at its lower end with a threaded extension to receive the cap support. In this support, shown in one of the small figures, is a cap nipple or seat, from which a vent leads to permit the passage of the flash to the powder. The hammer rod, extending through the bore, may be made sufficiently heavy to fire the cap by gravity, but in order to render the operation more certain, and to permit the device to be operated in a horizontal as well as a vertical plane, a spring is employed, bearing between shoulders on the hammer rod and within the bore. A detent or latch pivoted to the body of the plug serves to hold up the hammer rod, the latch being released by the operator, at a safe distance, pulling on a cord attached thereto, when the descending hammer rod fires the cap and explodes the charge.



WINDER'S BLASTING PLUG.

A MACHINE FOR TRUING VALVE PLUGS, ETC.

A device for centering a valve stem or valve casing, etc., providing also means for grinding or burring the plug or seat of the centered valve-stem or casing, has been patented by Mr. Daniel F. Dunn, and is shown in the accompanying illustration. Upon the end of an exteriorly screw-threaded stationary tubular spindle, suitably supported, are formed ear pieces to which are pivotally hung the ends of clamp arms having inward bends near their outer ends, with clamping jaws to embrace a valve stem. The clamp arms also have rear lugs pivotally connected by links with a sleeve fitting loosely upon the screw-threaded tubular spindle, there being an internally screw-threaded hand wheel to the rear of the sliding sleeve, by turning which the jaws of the clamp arms are firmly fixed upon the stem of the valve plug to be centered, which is thus brought in axial line with the spindle. The crank arm on the end of the burr shaft can then be forced inwardly for its conical burred opening to lie upon and around the end and edge of the valve plug, when, by rotating the shaft by means of the crank handle, the valve plug is ground perfectly true and concentric with the axial line of its stem. The mechanism permits the substitution of burr shafts having heads with grinding surfaces of different characters or forms, suitable for use upon other articles clamped by the jaws, in which a valve casing or body may likewise be clamped and centered, with the axial line of its seat coincident with the axial line of the burr shaft, which is then provided with a conical shaped cutting or grinding head.



DUNN'S MACHINE FOR TRUING VALVE PLUGS, ETC.

For further particulars with reference to this invention address Messrs. B. F. Dunn & Co., P. O. box 705, Columbus, Ohio.

IN Nebraska, where glandered horses are exterminated by order of the authorities, the State pays the owner for the value of the animal. It is said quite a profitable business is carried on by parties who take over the State line lots of diseased horses from Dakota, Iowa, and other localities for the purpose of receiving the bounty.

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THE HORNED LIZARD.

The Museum of Natural History at Paris has now in its possession a curious reptile that came from Saint Domingo. It bears the name of horned lizard, which was given it by Lacepede. Mr. Wagler has since put it into the genus *Metopoceros*.

In brief, it is a saurian of the family Iguanidæ, distinguished from the iguanas, properly so called, by having teeth like those of the cycluras, and by two rows of hairs that are to be seen under the thighs. The only species known is the *M. cornuta*, which is remarkable for its forehead being surmounted by a large horn-like tubercle.

This lizard, in form, reminds us of those enormous fossil dinosaurs known as iguanodons, the remains of which have been found in the Wealden cretaceous formation, and very recently at Bernissart, Belgium.

The horned lizard is about twenty-eight inches in length. Its body is gross and squat, of a brown color, and the line of the back is covered with spines that point backward, from the back of the head to the beginning of the tail, where there is a small space destitute of them. The tail is not cylindrical like that of our lizards, but is compressed laterally, and is provided with strong muscles that allow the animal to switch it abruptly and powerfully in either direction in order to defend itself when any one tries to touch it.

Back of the head, which possesses remarkable peculiarities, the back is provided with a sort of hump. The head, which is surmounted in front with a dermic horn, is large and inflated on each side at the back. Under the lower jaw, we observe a fold in the skin, flanked on each side by large pockets that give the animal, in a face view, a most curious aspect.

The collection of the museum contains but few examples of this saurian, and this is the first time that a living specimen has reached the menagerie. So its habits are not known. However, since its arrival it has been observed to be slow of gait, and to make certain vertical motions of the head. When it is approached, it seems to like to give itself as wicked an air as possible. It is fed upon lettuce leaves and a little meat; but it has not much appetite. The horned lizard is a near relative of the cycluras, anolises and amblyrhynchuses. These latter were studied by the celebrated Darwin in the Galapagos Archipelago. It is probable that their habits resemble those of the Metopoceros. There are two species of them, one aquatic (*A. cristatus*), and the other terrestrial (*A. Demarlii*). In speaking of the last named species, Darwin tells us that the animals eat during the day and wander but a short distance from their burrows, and, when frightened, run back to the latter in the most comical manner. They cannot run very swiftly except when they are descending sloping ground. This is evidently due to the lateral position of their legs. They are not timid. When they are looking at some one attentively they lift their tail, and, rising upon their fore legs, they keep moving their head up and down and try to put on as vicious an air as possible. But, as a fact, they are not vicious; and if one stamps his foot, their tail at once comes down, and they scamper away as quickly as possible. Darwin observed that the young, which eat flies, give their head exactly this same up and down motion when they observe anything.

THE HORNED LIZARD.

This same species excavates burrows just beneath the surface, and when a person is walking in a place inhabited by these animals, he keeps constantly sinking. They dig with the feet of one side of the body at a time, and when these are tired they use the feet of the other side, and so on alternately.

It may be conceded that the amblyrhynchuses, as regards habits, have resemblances with the horned lizard, which, like them, belongs to the Iguanidiæ.—*La Nature.*

Progress of Our Southern Neighbors.

A bill has been introduced in the House of Representatives to authorize the President to invite the several governments of the republics of Mexico, Central and South America, and the empire of Brazil to join the United States in a conference to be held at Washington, for the purpose of discussing and recommending for adoption to their respective governments some plan of arbitration for the settlement of disagreements and disputes that may hereafter arise between them, and for considering questions relating to the improvement of business intercourse between said countries, and to encourage such reciprocal commercial relations as will be beneficial to all and secure more extensive markets for the products of each of said countries.

In the course of the discussion an able and brilliant speech in support of the bill was made by the Hon. Mr. McCreary, of Kentucky, from which we take the following:

There are south of our republic fifteen republics and the empire of Brazil, and they cover an area ten times the size of France, Spain, Prussia, and Italy. They are as large as the United States and the whole of Europe combined. The population of those countries amounts to about 50,000,000 of people. They are connected to us by land, and most of them are nearer to New York than is the State of California, and yet to many of the people of the United States the republics of Central and South America are almost unknown.

In 1887 our exports were valued at $752,180,902.

Of this amount we exported but $64,719,000 to Mexico and South and Central America.

Our annual mechanical and agricultural products are valued at about eleven thousand millions of dollars, while we seldom have sold more than $75,000,000 worth of these products to our nearest neighbors, who buy in Europe at least three times as much as they get here.

The total commerce of the countries named in 1885 was as follows:

Imports	$331,100,599
Exports	391,294,781

Of the $331,100,599 of merchandise sold to those countries, the share of the United States was only $42,598,469. Yet we are their closest neighbor.

The report of the commissioners sent by our government to Central and South America shows that the development of the southern half of South America is nearly as rapid as that of the United States. Immigration is flooding in, internal improvements are opening new and fertile fields, and wealth is increasing in a ratio not exceeded by any other section of the globe.

Chili, Uruguay, and the Argentine Republic, almost a *terra incognita* to many, are booming like our Western States and Territories. In 1876 the imports of the Argentine Republic were valued at $36,000,000. In 1884 they had reached $80,000,000. In 1876 the merchandise brought to that country from England, France, and Germany was valued at only $18,000,000, while in 1884 it was more than $53,000,000. The entire imports from the United States for twenty years were $6,000,000 less than those from the three commercial nations of Europe just named for the year 1884.

In the last two years the government of the Argentine Republic has made contracts for $59,000,000 worth of railway improvements, including a line of road northward into Bolivia and two lines in the direction of Chili and Peru, so as to bring the commerce of the Pacific slope into the harbor of Buenos Ayres, instead of taking it around the Straits of Magellan.

In 1874 the foreign commerce of Chili amounted to $42,000,000. In 1884 it reached $132,000,000. From $50,000,000 to $60,000,000 in merchandise is imported into Chili every year, of which England furnishes over $25,000,000, France over $12,000,000, Germany over $8,000,000, and the United States $3,000,000.

Adding the imports of Brazil to those of Uruguay, Chili, and the Argentine Republic, it will be found that the aggregate value of manufactured products introduced into those four countries annually reaches the enormous sum of $250,000,000, of which England furnishes about one-half, France about $50,000,000, Germany about $35,000,000, and the United States about $17,000,000.

We have no adequate conception of the present magnitude of these markets, nor of their prospective value. The manufacturers of the United States can supply almost every article represented in that $250,000,000. From the report of the commissioners to South America I have gathered some remarkable facts.

We have more trade with either Belgium, Italy, the Netherlands, Spain, Switzerland, Russia, China, Japan, and Australia than we have with all the Central American States combined. We have nearly as much trade with Greece as we have with Chili. We sell more sewing machines in Switzerland than we sell in Chili, and Switzerland sells Chili more sewing machines than she buys of us.

Bolivia has a foreign trade of over $16,000,000 a year, yet the name of that country does not appear in the tables of our Bureau of Statistics. The chief imports of Bolivia are cotton and woolen goods, agricultural implements, mining machinery, hardware, cutlery, clocks, watches, canned goods, and provisions, a list which could be filled in any commercial city of the United States as cheaply as in Europe, and yet the annual reports of the Treasury Department of the United States do not show a dollar's worth of commerce between the United States and that country.

The most absurd spectacle in the commercial world is our trade with Brazil. We buy nearly all her raw products, while she spends the money we pay for them in England and France. In 1884, of the exports of Brazil, $50,266,000 went to the United States, $29,000,000 to England, and $24,000,000 to France. Of the imports of Brazil in the same year, $35,000,000 came from England, $15,000,000 from France, and only $8,000,000 from the United States.

The climate in those countries is warm, and the people use for clothing large quantities of cotton goods. Yet, although we produced last year in this country between five and six millions of bales of cotton, it is a remarkable fact that of the $65,000,000 expended by Central and South America for cotton goods last year, over $50,000,000 went to the merchants and manufacturers of England.

The countries of Central and South America need the products of our furnaces, of our factories, and of our farms. They need nearly everything we produce, and we need nearly everything they produce. They need American watches, American machinery, American mowers and reapers, American sewing machines, telephones, scythes, saws, shovels, hoes, axes, indeed nearly everything of which we have a surplus in this country. The map of the world does not show a region that has greater resources or greater possibilities than have North America, Central America, and South America.

I believe in less than twenty years there will be railroad communication between the city of New York and the capital of the Argentine Republic, Buenos Ayres. A few years ago, before the Central and Union Pacific Railroads were constructed, by which New York and San Francisco were connected by rail, the obstacles in the way of that work were greater than those which now exist in the way of connecting New York by rail with the capital of the Argentine Republic. Already the grand movement has commenced. To-day there is railroad connection between New York and the capital of Mexico, and arrangements have been made between the Mexican Republic and the Republic of Guatemala for the construction of a railroad from the city of Mexico to the capital of Guatemala.

That has been done on this end of the line. If you go to the other end, you find that the Argentine Republic is now engaged in building a railroad from Buenos Ayres, its capital, to its northern boundary line; and when the railroad gets to that northern line, there will come into operation a contract already made by Bolivia, giving $40,000 per mile and 11 square leagues of land to an English company that has agreed to build the railroad from the line between the Argentine Republic and Bolivia to the capital of Bolivia. What is left? But little over 3,000 miles between the capital of Bolivia and the capital of Guatemala; and I assert that the probability of the construction of that railroad is stronger to-day than was the probability of the construction of the Central Pacific and Union Pacific ten years before they were built.

The Sand Freezing Process.

A recent number of the *Annales Industrielles* states that a mine shaft is being successfully sunk by M. Alexandre, of the Houssu Company, in Belgium, through a stratum of moist sand 12 m. thick, met with at 70 m. depth, by the Poetsch method, which consists in freezing the sand, then excavating it like rock. In the present case ten iron tubes, with cutting crown, are inserted in the sand at about 1 m. interval, penetrating the coal below. Into these are put other tubes, through which is passed a very cold liquid, to return by the larger tubes—generally chloride of magnesium cooled by expansion of ammonia. The sand is frozen more than 3 m. round the tubes. It has the appearance of a rock harder than the compact chalk of the English Channel tunnel. It is sparkling and speckled with particles of coal. The chloride of magnesium, injected at —14° C., returns at —12°. A thermometer inserted 10 cm. in the stratum read —8°. M. Poetsch's method was some time ago applied to making a tunnel at a small depth under part of the city of Stockholm, as described and illustrated in our pages.

M. HIGNETTE makes a white artificial stone from sand which has been used for polishing plate glass.

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ENGINEERING INVENTION.

An automatic railroad switch has been patented by Mr. William H. Stowell, of Eureka, Nevada. A heavy central rail is curved to the deflection required and permanently secured to the cross ties, while a deeply flanged wheel is secured beneath the engine, adapted to be raised or lowered to the level of the central rail, to engage therewith, by which means the direction of the train is controlled.

AGRICULTURAL INVENTIONS.

A corn harvester has been patented by Mr. Jesse L. Lamont, of Atkinson, Ill. The machine is designed to simultaneously remove the ear from the stalk and husk it, the husked ears being pushed rearward and delivered to an elevator or conveyor mechanism which will deliver the ears to a wagon or other suitable receptacle.

An attachment for corn planters has been patented by Mr. William H. Bowman, of South Solon, Ohio. It is a check attachment applicable to any style of corn planter, and may also be used for drilling the corn, the construction also providing means whereby in irregularly shaped fields the checking may be accomplished as regularly as in rectangular fields.

A harrow for listed crops has been patented by Mr. Hugh A. Murphy, of Elk City, Kansas. It consists of a number of narrow harrow sections yieldingly supported by elevated connecting rods, the harrow sections being made adjustable, the invention providing an implement by which ground that has become hard baked may be broken up and pulverized.

MISCELLANEOUS INVENTIONS.

A nut lock has been patented by Messrs. Frank and John Rennie, of Dayton, Ohio. It consists of a rod formed with a bolt-receiving loop, one of the ends of the rod being bent over upon itself toward the loop to form a nut-locking arm.

A combination lock and alarm has been patented by Mr. Robert Baumann, of St. Louis, Mo. The invention covers a novel construction and arrangement of parts and combinations of the same, making an improved alarm lock for doors, money drawers, etc.

A mop holder has been patented by Mr. Benjamin F. Gilbert, Jr., of Fair Haven, Vt. The bail is pivotally secured to the handle, to which also is pivotally secured a clamp jaw, the bail forming a guide for the ends of the clamp jaw, the handle in no way interfering with the insertion and removal of the mop.

A basket bottom has been patented by Mr. Albert W. Beckett, of St. Catharines, Ont., Canada. It is stamped up from sheet metal or paper or other suitable material, and provided with base corrugations to give the required strength, and with other corrugations and perforations to receive the side standards.

A tension device for the warp beam of looms has been patented by Mr. Chester Bailey, of Janesville, Wis. The tension is increased or diminished according to the locality of a weight upon a lever, the weight being automatically and continuously moved toward the fulcrum as the diameter of the roll of warp diminishes, thus maintaining a uniform tension.

A bottle has been patented by Mr. Henry Ader, of Somerset, Ind. It is a cylindrical body with threaded ends and a cross partition dividing it into two compartments, in which two substances may be carried and kept separate, the upper compartment being available for fluids, while the lower one may be used for pills, powders, etc.

An earth scraper has been patented by Mr. Julius D. Brainard, of Highmore, Dakota Ter. It has a scoop-locking device, a rotary handle bar, and connections between them for operating the locking device, with other novel features, whereby the scraper can be brought back after each dumping action exactly to the point where the previous scraping ended.

A folding stand for camp stools has been patented by Mr. Albert Cooper, of Brooklyn, N. Y. Rods constitute the legs, hinged at their upper ends in a cup or frame, other seat or top rods supporting the seat, hinged at their lower ends in a lower cup or frame, the upper and lower cups or frames being apertured to receive, brace, and guide the seat rods and the legs.

An apparatus for treating cereals has been patented by Mr. Henry R. Robbins, Jr., of Baltimore, Md. The invention relates to a means of cooking cereals by steam in accordance with a former patented invention of the same inventor, for more conveniently and expeditiously charging and discharging the receptacle and economically and uniformly treating the materials.

A felting roll for hat sizing machines has been patented by Mr. Aaron T. Clark, of Newburg, N. Y. It is of a novel yielding construction on its acting surface and throughout the main portion of its body, to have a continuous yielding spiral pressure-like action upon the hat bodies, thereby making the quality of work more even and more closely resembling such work done by hand.

An air pump governor has been patented by Mr. Edward G. Moore, of Wilmington, Del. It is a novel construction especially adapted for the air pumps of locomotives, to prevent an excess of pressure in the train pipes, and to cause an accumulation of air in the air reservoir while the brakes are applied, thus permitting an instantaneous release of the brakes when desired.

A stove for burning light fuel has been patented by Mr. Raymond O. Peyton, of Terre Haute, Ind. It has a cylindrical body of sheet iron, adapted to rest unattached upon the stove legs, one head of the cylinder being permanently attached while the other head is detachable and constitutes the door, with other novel features, making a cheap portable stove.

A flour bolting reel has been patented by Mr. Washington Gilleland, of Land, Ga. The sections of bolting cloth are secured to the reel frame in a novel and improved manner, the construction being such that the reel will work faster and the flour be bolted cleaner, while the sections of bolting cloth may be removed separately from the reel for repair or replacement without disturbing the other sections.

A soot collector for gasoline stoves has been patented by Margaret M. Joslyn, of Grand Meadow, Minn. It consists of an inverted funnel placed over the burner while the gasoline is being burned, with its wider end opening downward and its narrower end closed by a perforated sheet metal disk, the smoke passing through the apertures of the disk being received on a moistened cloth thrown over the funnel.

A cotton press has been patented by Messrs. Peter L. and William Brady, of Hearne, Texas. It has two series of rollers arranged in a circle, one series journaled in a movable carriage, and both series receiving motion from drive wheels on opposite sides of the machine, the cotton being compressed by a continuous operation as received from the gin, and the bale cover wrapped around and fastened by ties when the bale is wholly inclosed by the press.

A road machine and road digger and scraper form the subject of two patents issued to Mr. Alberto Finks, of New Berlin, N. Y. The invention covers a carriage or main frame, a digger bar and scraper bar, and elevating devices, the invention consisting particularly in the novel constructions for elevating the bars and adjusting the angle of the scraper bar, while the scraper, being concaved in front and under edge, gives better results than a straight scraper, covering more surface in its travel, and the machine is simple and strong.

SCIENTIFIC AMERICAN BUILDING EDITION.

MARCH NUMBER.—(No. 29.)

TABLE OF CONTENTS.

1. Elegant plate in colors, showing perspective elevations and floor plans of a cottage of moderate cost, together with full specifications, sheet of details, etc., etc.
2. Plate in colors of a handsome suburban residence, costing about Twelve Thousand Five Hundred Dollars, with floor plans, specifications, sheet of details, etc.
3. Elevations and floor plans of two dwellings of moderate cost.
4. Perspective view and floor plans of a house for Six Thousand Dollars.
5. Floor plans and elevations of a substantial residence at Tuxedo Park.—James Brown Lord, architect.
6. Perspective and two plans of a Cape Cod cottage of moderate cost.
7. Plans and perspective of a double house, costing about Six Thousand Five Hundred Dollars.
8. Elevation and plans of an alteration of a dwelling on Long Island.
9. Sketch of a one story residence erected at Birmingham, Ala., at a cost of Four Thousand Five Hundred Dollars.
10. Floor plans and perspective view of a neat cottage for Seventeen Hundred and Fifty Dollars.
11. Plans of an English country house.
12. Sketch of a handsome double house at Cleveland, Ohio. Cost, complete, Six Thousand Dollars.
13. Illustration of a house costing Three Thousand Dollars.
14. Designs of two substantial churches, costing about Four Thousand Dollars each.
15. Elevation and floor plans of a brick residence at Newark, N. J. Cost, complete, Seven Thousand Six Hundred and Seventy-five Dollars.
16. Sketch of the hall and stairway of a luxurious English dwelling.
17. Design for a carriage house and stable. Cost, Fifteen Hundred Dollars.
18. Plan of an old plaster ceiling, South Quay, Yarmouth.
19. Architectural Suggestions.—A Stairway in the Hotel Cluny.—A Stairway in Rouen.
20. Miscellaneous Contents: Ancient Water Works.—Making the House Water-Tight.—Mahogany.—Vibration of Buildings.—Building Accidents.—The Column Vendome, Paris.—Learning to Design Buildings.—Non-Inflammable Wood.—Large Redwood Boards.—An Experiment on the Expansion of Iron in Buildings.—Ornamental Hedges.—The Acoustics of Buildings.—Suggestions on House Painting.—Right and Left in Landscape Painting. Furniture Woods.—Range Boiler Explosion, with illustrations.—Plastering of Walls, Westminster Hall.—Notes on Bricks.—Mineral Wool.—The Jackson Ventilating Grate, illustrated.—The Spencer Hot Water Heater, illustrated.—The Alsop Furnace, illustrated.

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The *Railroad Gazette*, handsomely illustrated, published weekly, at 73 Broadway, New York. Specimen copies free. Send for catalogue of railroad books.

The Knowles Steam Pump Works, 113 Federal St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

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The Holly Manufacturing Co., of Lockport, N. Y., will send their pamphlet, describing water works machinery, and containing reports of tests, on application.

Lathes for cutting irregular forms a specialty. See ad. p. 62.

Curtis Pressure Regulator and Steam Trap. See p. 77.

Billings' Drop Forged Steel C Clamps. Drop Forgings, all kinds. Billings & Spencer Co., Hartford, Conn.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Gang drills for light work, 3/8 and under. Automatic or lever feed. Dwight Slate Machine Co., Hartford, Conn.

60,000 *Emerson's* 1887 ☞ Book of superior saws, with Supplement, sent free to all Sawyers and Lumbermen. Address Emerson, Smith & Co., Limited, Beaver Falls, Pa., U. S. A.

Friction Clutch Pulleys. D. Frisbie & Co., N.Y. city.

Paint mills. Chas. Kaestner & Co., Chicago, Ill.

Practical working drawings of machinery made by A. K. Mansfield & Co., 280 Broadway, N. Y. Correspondence invited.

"The Improved Greene Engine." Flat slide valves, both steam and exhaust. Providence, R. I., Steam Engine Co., *sole* builders.

Pedestal tenoner. All kinds woodworking machinery. C. B. Rogers & Co., Norwich, Conn.

"How to Keep Boilers Clean." Send your address for free 88 page book. Jas. C. Hotchkiss, 120 Liberty St., N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Engines and boilers. Chas. Kaestner & Co., Chicago, Ill.

Send for new and complete catalogue of Scientific Books for sale by Munn & Co., 361 Broadway, N. Y. Free on application.

NEW BOOKS AND PUBLICATIONS.

ANIMAL LOCOMOTION. By Eadweard Muybridge. 1872–1885. Plates. University of Pennsylvania.

Mr. Eadweard Muybridge may justly claim a title to the remembrance of posterity as being a systematic worker in photographic studies of animal movements. His first work was done in California, and at once attracted the attention of the world. Recently he has carried on his investigations under the auspices of the University of Pennsylvania, and as a result has secured many hundred plates of human beings and of animals in motion. He has selected representatives of both sexes, of average and of abnormal sizes and of different ages, and has studied the movements of each. He has photographed successive phases of running, jumping, dancing, and every form of motion. A child creeping on hands and knees is reproduced, showing the same succession of steps that are found in the regular progression of animals. In an elaborate analytical table the different plates are classified, in order that any given selection can be made. For artists especially the work is invaluable. With its results to study there should be no excuse in painting for the constrained positions often servilely copied from a tired model. The complete series comprises over 100 large photographs from instantaneous plates, each plate showing from 12 to 36 figures in different positions. It is a remarkable work, and its realization has involved a vast amount of labor and perseverance.

THE GEOLOGICAL EVIDENCES OF EVOLUTION. By Angelo Heilprin. Philadelphia: Published by the author. 1888. Pp. 99.

This little work, elegant in its printing and illustrations, is an amplification of a lecture delivered by Prof. Heilprin, at the Academy of Natural Sciences, Philadelphia. It is an earnest argument in favor of Darwinism, which the author regards as conclusively proved. He ends by saying that if the geological facts cited are not conclusive in favor of evolution, then "science is a delusion and a snare, and we will be compelled to begin anew our conception of the universe." The history of science in the past is a history of errors, and the assertion, while meant to be very broad, can hardly be so regarded in the light of the small extent of modern knowledge. Until some few of the primary facts in nature are accounted for, until gravitation, light, electricity, and molecular and atomic forces are put upon an intelligible basis, it is too soon to consider any purely theoretical conception as proved. The well known clearness and precision of the author's style are discernible throughout the work and make it most agreeable reading, whether we consider that the Darwinian theory is proved or not by the facts brought forward in less than one hundred small pages. The elegant plates which represent fossil remains with photographic accuracy form one of the pleasing features of this admirable book. Prof. Heilprin's work is every day acquiring more recognition, and this treatise will be no detriment to it.

HARVARD REMINISCENCES. By Andrew P. Peabody, D.D., LL.D. Ticknor & Co. Cloth. Price $1.25.

This little work contains a number of sketches of the prominent men whose names appeared as college officers at Harvard nearly sixty years ago. Among them may be mentioned Josiah Quincy, Edward Everett, Henry Ware, John G. Palfrey, Charles Follen, John Langdon Sibley, C. C. Felton, Benj. Peirce, etc. The memoirs consist of personal reminiscences of the authors. The work concludes with a picture of college life at Harvard when the author was a student there, in the twenties, and a more striking illustration of the change that has taken place in our customs can hardly be found. Morning prayers at six in the morning, evening prayers at six o'clock, a recitation immediately after morning prayers, and then breakfast, which consisted simply of coffee and hot rolls. Dinner at half-past twelve, and in the evening tea and rolls for supper. The rooms were furnished with plain pine furniture, a bed and washstand and table or desk and a few chairs being the full complement of a well equipped room. A carpet was a luxury only indulged in by the very rich, and even then only during the latter part of one's course. The book will be of interest to Harvard graduates.

DES EMPLOIS CHIMIQUES DU BOIS DANS LES ARTS ET L'INDUSTRIE. Par Othon Petit. Ingenieur Librairie Polytechnique. Baudry et Cie., Paris, France. 1 vol. 8vo, paper. 1888. Price $5.

The author treats of the subject of wood and the various processes by which the composition of the wood is destroyed or altered in such a way as to liberate certain of its elements, such as carbon, methyl alcohol, acetic acid, cellulose, tannic acid, etc. Combustion produces a complete chemical transformation of the elements of which the wood is composed. The manufacture of tannin and paper pulp alone have brought on a perfect avalanche of patents, many of which are based upon principles that are faulty or incomplete. The object of the present work is to furnish such data as may be of future use in the treatment of wood by chemical processes, and also a description of the apparatus employed in carrying out these processes. The treatise comprises papers on the composition of vegetable tissues, upon wood considered as combustible, on the extraction of carbonate of potash, on the manufacture of charcoal, tar, turpentine, on distillation of various spirits, on the manufacture of tannin and paper pulp, and the transformation of wood into glucose. There is also a list of French patents relative to the extraction of tannin and the manufacture of paper pulp from January 1, 1870, to January 1, 1887.

WIDE AWAKE. An illustrated magazine. We have received copies of this eminently "Wide Awake" monthly magazine, published at $2.40 a year by the D. Lothrop Co., of Boston, Mass. In its elegance of illustration and typography it leaves nothing to be desired, while its wide range of topics should please every taste. Many of the articles are accompanied by fac-similes of the author's signature, which to many is a feature of interest. The cover, a floral design in subdued tints of the crushed strawberry type, is extremely delicate and attractive.

Received.

PRACTICAL PHYSICS FOR SCHOOLS AND THE JUNIOR STUDENTS OF COLLEGES. ELECTRICITY AND MAGNETISM. By Balfour Stewart, F.R.S., and W. W. Haldane Gee, B.Sc. London and New York: Macmillan & Co. Pp. 221. Price 60 cents.

HOT WATER SUPPLY. A Practical Treatise upon the Fitting of Hot Water Apparatus for Domestic and General Purposes. By F. Dye. London and New York: E. & F. N. Spon. Pp. 82. Price $1.

HOME SANITATION. A Manual for Housekeepers. By the Sanitary Science Club of the Association of Collegiate Alumnæ. Boston: Ticknor & Co. Pp. 80. Price 50 cents.

HANDBOOK FOR STEAM USERS. Being Rules for Engine Drivers and Boiler Attendants, with notes on Steam Engine and Boiler Management. By M. Powis Bale. London and New York: Longmans, Green & Co. Pp. 95. Price 75 cents.

☞ Any of the above books may be purchased through this office. Send for new catalogue just published. Address MUNN & Co., 361 Broadway, New York.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(1) E. D. and many others.—Any body, as a sphere of metal, that is impervious to water, and hollow, so as to be but little more than the specific gravity of water at the surface, will find its equilibrium at considerable depths in the sea. Water is but slightly compressible, and although there is immense pressure at great depths, the specific gravity is but slightly raised; hence all objects that are slightly heavier than water sink to the bottom of the sea at great depths. Aluminum, one of the lightest metals, will quickly find the bottom of the deepest seas.

(2) D. M. G. asks for a preparation to be used as the —— hand grenades, to extinguish fires. Wish to use ordinary quart glass flasks, and would like the solution not to freeze in ordinary temperatures in our State (Michigan). A. A solution of common salt or sulphate of soda in water, making a strong brine, forms a good home-made fire extinguisher, and such solutions do not freeze easily. By adding lime dust and sulphuric acid, and corking tightly, carbonic acid is generated under pressure, but this gas easily escapes if not most securely sealed. We cannot specify the composition of the various patented solutions, for which reference must be made to the patents. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 358 and 535, for valuable articles on this subject.

(3) G. K. writes: I have a pair of buck horns I wish to mount; what should I use to whiten and polish the skull connecting the horns, also what is the best polish for the horns themselves? A. You can bleach the shell by dipping into a solution of hydrogen peroxide or a solution of chloride of lime. To polish the horns, first scrape with a glass or steel scraper to take off any roughness, then grind some pumice stone to powder and with a piece of cloth wetted and dipped in the powder rub them until a smooth face is obtained. Next polish with rotten stone and linseed oil, and finish with dry flour and a piece of clean linen rag.

(4) E. H. D. desires (1) recipes for making purple, green, and black type writer copying inks. A. Use any desired aniline color. Dissolve in 15 parts alcohol, and add 15 parts glycerine. 2. What photographic preparation is most sensitive to artificial light, and how is it compounded? A. Gelatino-bromide of silver is the most sensitive. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 541.

(5) E. E. S. asks how photographs can be mounted on ordinary writing paper, so they will not wrinkle and curl. A. Roll the damp prints up in little bundles with the albumen face outward and allow them to dry spontaneously; each bundle is rolled in a sheet of note or foolscap paper. When the prints are dry they are flattened and placed in a book or portfolio, and are then ready to be trimmed. Make a solution of bleached shellac in alcohol, so that it will be somewhat thick. The print is laid face downward and its back covered with the shellac solution; it is then mounted in the usual way upon the card mount or other thin paper support. Allow no shellac to get on the face of the print, as it cannot be removed without injuring it.

(6) G. A. D. asks: What is a good receipt for making a pure baking powder, and how should it be used? A. One of the simplest and best receipts for a baking powder is the following: Take of powdered cream tartar 30 ounces, bicarbonate of soda 15 ounces, flour 5 ounces. All of the ingredients must be well dried. Mix thoroughly and keep dry.

(7) E. D. F. asks the best stain for red, blue, and wine color, by dipping, for cheap chairs. A. For red boil 1 pound Brazil wood and 1 ounce pearlash in a gallon of water, and while hot brush over the work until of a proper color. Dissolve 2 ounces alum in 1 quart of water and brush the solution over the work until it dries. For blue, boil 2 ounces of indigo, 2 lb. of wood, and 1 ounce alum in 1 gallon water, brush well over until thoroughly stained. For wine color, ground Brazil wood 1 pound, water 3 quarts, cochineal ½ ounce; boil the Brazil wood with the water for an hour, strain, add the cochineal, boil gently for half an hour, and it will be read for use.

(8) C. R. asks how to remove black heads, better known perhaps as comedones. A. Water in which ammonia has been dissolved frequently will entirely remove the cause of your complaint. The following paste is also largely used. Take of kaolin 4 parts, glycerine 3 parts, acetic acid 2 parts; make into a pomade with the addition of a little ethereal oil. See SUPPLEMENT, No. 542.

(9) J. R. writes: In carbonate potash solution recommended to preserve iron or steel tools from rust, what strength should solution be made? A. One-quarter pound carbonate potassa dissolved in one gallon of boiling water. Dip the work in the hot solution.

(10) F. K. asks (1) how to prepare bird lime. A. Boil the middle bark of the holly 7 or 8 hours in water, drain it, and lay it in heaps in the ground covered with stones for 2 or 3 weeks, till reduced to a mucilage. Beat this in a mortar, wash it in rain water, and knead until free from extraneous matters. Put it into earthen pots, and in a few days it will be ready for use. An inferior variety is made by boiling linseed oil for some hours until it becomes a viscid paste. 2. Is there any way to make wood elastic? A. No.

(11) E. M. P. asks how he could make a good stain for brick that would be permanent and not wash off with the rain. A. Dissolve 1 ounce of glue in a gallon of water, and when hot put in a piece of alum the size of an egg, ½ pound Venetian red, and 1 pound Spanish brown. Try a little on the bricks; if too light, add more red and brown; if too dark, put in more water.

(12) J. P. H. H. desires a receipt for removing discolorations from granite caused by overhanging trees, something that will restore it to original color, without damaging the stone. A. Try a weak solution of hydrochloric acid or a solution of caustic potash.

(13) G. Z. asks what the difference is between Epsom, Rochelle, and arlsbad salts, also tests for crystalline corrosive sublimate or mercuric chloride and sulphate of iron. A. Epsom salts are magnesium sulphate, Rochelle salts are the tartrate potash and soda, and Carlsbad salts are the solid residue obtained by evaporating the water of that celebrated spring in Austria. Corrosive sublimate should be perfectly soluble in sufficient water and in ether, and should be perfectly volatile. It gives a black precipitate with hydrosulphuric acid insoluble in dilute warm nitric acid. Sulphate of iron gives a pale blue precipitate with ferrocyanide of potash that darkens on exposure to the air. Many other tests could be given.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. **Address** MUNN & CO., office SCIENTIFIC AMERICAN, 361 **Broadway, New York.**

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

February 28, 1888,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid, apparatus for making sulphurous, C. E. Getchell ... 378,673
Acid, treating sludge, H. De Grousilliers ... 378,774
Air brake, automatic, R. Solano ... 378,628
Air brake, automatic electric, J. F. Carpenter ... 378,657
Amalgamating gold and silver, W. W. Wheeler ... 378,750
Animal trap, Cattell & Summers ... 378,767
Animal trap, E. Herrington ... 378,789
Animal trap, live bait, E. Herrington ... 378,790
Ant trap, M. C. Miller ... 378,709
Arc light, L. N. P. Poland ... 378,616
Axle box, car, J. Stephenson ... 378,477
Axle truss, wagon, O. J. Williams ... 378,585
Bag. See Paper bag.
Bags, frame for traveling, W. Roemer ... 378,620
Bags, frame for traveling, F. C. Schmidt ... 378,623
Baling press, Frey & Schwarzburg ... 378,831
Barrels and other vessels, composition for filling up cracks in, Klein & Schattels ... 378,596
Basket, L. A. Brown ... 378,492
Basket bottom, A. W. Beckett ... 378,757
Bath. See Blotter bath.
Battery. See Secondary battery.
Battery vessels, J. Wiest ... 378,484
Batteries, automatic switch for secondary, J. S. Sellon ... 378,527
Bed, couch, J. P. Miller ... 378,708
Bedstead, adjustable crib, C. Morse ... 378,455
Belt, chain, C. W. Hunt ... 378,686
Bicycle support, J. F. Conley ... 378,496
Bin. See Feeding bin.
Blast furnace, E. A. Wheeler ... 378,749
Blast furnace bosh plate, J. Kennedy ... 378,550
Blasting plug, A. Winder ... 378,820
Bleaching by electrolysis, apparatus for, Hermite & Cooper ... 378,651
Block. See Pulley block. Stove block.
Blotter and pen wiper, combined, E. Promis ... 378,719
Blotter bath, H. F. Arnold ... 378,641
Board. See Mould board.
Boat detaching apparatus, R. M. G. Brown ... 378,763
Boats, construction of, A. Olsen ... 378,613
Bolt, W. W. Woodford ... 378,857
Boots and shoes, lasting, J. W. Hatch ... 378,444
Boots and shoes, manufacturing, J. W. Hatch ... 378,445
Bottle, H. Ader ... 378,752
Bottle stopper, F. P. Morhous ... 378,800
Bottle stopper, W. H. Underwood ... 378,743
Bottles, combined spreader and stopper for mucilage and other, W. H. Underwood ... 378,744
Box. See Axle box.
Box, A. T. Linderman ... 378,601
Brick machine, J. C. Anderson ... 378,538
Bridge cables, suspender connection for, G. Lindenthal ... 378,697
Bridges, cable for suspension, G. Lindenthal ... 378,696
Brake. See Air brake.
Brush, Foster & Kennedy ... 378,784
Buckle, J. England ... 378,667
Buckle, A. Prym ... 378,555
Buckle, D. L. Smith ... 378,730 to 378,734
Buckle, turn, C. H. Williams ... 378,534
Buggy top, G. Wiggins ... 378,485
Buildings, construction of, A. Smith ... 378,627
Burner. See Gas burner. Hydrocarbon burner. Vapor burner.
Burnisher, W. H. Boles ... 378,760
Bustle, J. Galvin ... 378,489
Camera tripod, W. H. Carpenter ... 378,430
Cane shaving machines, gauge attachment for, L. Janson ... 378,591
Cane stripper, R. P. Sorrels ... 378,735
Car, aisle, J. Stephenson ... 378,480
Car bumper, A. W. Van Dorston ... 378,532
Car coupling, J. Haish ... 378,676
Car coupling, McCray & Shade ... 378,702
Car coupling, W. T. Van Dorn ... 378,813
Car, freight, H. V. Lucas ... 378,602
Car dash trap, tram, J. Stephenson ... 378,476
Car door hanger, tram, J. Stephenson ... 378,474
Car door hanging, tram, J. Stephenson ... 378,472
Car door operator, tram, J. Stephenson ... 378,472
Car lamp house, tram, J. Stephenson ... 378,469
Car, railway, J. A. Brill ... 378,428
Car, railway, H. C. Gross ... 378,675
Car roof, tram, J. Stephenson ... 378,470
Car sash rail, tram, J. Stephenson ... 378,471
Car, seal, Brown & Ketchum ... 378,655
Car seat, F. H. Henry ... 378,546
Car spring plates, die for making, N. H. Davis ... 378,773
Car wheel, G. G. Lobdell ... 378,844
Car window, tram, J. Stephenson ... 378,473
Cars, draw bar for tram, J. Stephenson ... 378,479
Cars, draw head hook for tram, J. Stephenson ... 378,478
Cars, sliding door for freight, C. H. Dunham ... 378,579
Cards, playing, F. Couch ... 378,497
Carriage door lock, W. P. Fest ... 378,582
Carriagemaker's grooving and boxing tool, J. A. Traut ... 378,854
Carriage tops, adjustable form for setting and building, C. C. Oakes ... 378,457
Carrier. See Store service apparatus carrier.
Case. See Pencil or pin case. Show case.
Cash carrier apparatus, pneumatic, G. B. Kelly ... 378,792
Cash carrier apparatus, pneumatic, W. A. Webber ... 378,533
Caster, furniture, Berkey & Fox ... 378,649
Caster socket, W. P. Tracy ... 378,740
Catarrh remedy, T. S. Greene ... 378,504
Cereals, apparatus for treating, H. R. Robbins, Jr ... 378,806
Chain, drive, B. A. Legg ... 378,599
Chair. See Dental chair. Rail chair.
Check hook, F. C. Kimball ... 378,795
Chopper. See Cotton chopper.
Churn, J. Ahrends ... 378,753
Churn, R. F. Collins ... 378,770
Churn, Gibbs & Harper ... 378,501
Clamp. See Flask clamp.
Clasp. See Corset clasp.
Clip. See Trace attachment clip.
Clock, advertising, G. Hoisholt ... 378,589
Clothes pounder, M. A. Nelson ... 378,711
Clutch, friction, Jones & Rogers ... 378,448
Clutch, friction, W. Oesterlein ... 378,803
Coal hod die, E. Barrath ... 378,755
Coal hods, die press for forming, E. Barrath ... 378,754
Combination lock and alarm, R. Baumann ... 378,568
Compasses, correcting device for ships', L. Sirieix ... 378,528
Cord or rope, machine for making, C. E. Brainard ... 378,491
Corn dropper, automatic, J. H. Stiggleman ... 378,808
Corn holder, hot, P. J. Godfrey ... 378,503
Corset and bustle, combined, P. Parmenter ... 378,518
Corset clasp, P. Laflin ... 378,691
Corset steel protector, E. Cushing ... 378,576
Cotton chopper, W. H. Harper *et al* ... 378,443
Cotton picker, J. W. Wallis ... 378,635
Cotton press, P. L. & W. Brady ... 378,570
Coupling. See Car coupling. Hose coupling. Thill coupling. Vehicle coupling.
Cranberries, device for picking, A. J. Disbrow ... 378,775
Culinary vessel, J. P. King ... 378,690
Culinary vessel, H. A. Manning ... 378,700
Cultivator, J. P. Black ... 378,651
Cultivator, N. Roggy ... 378,463
Cuspidor, D. H. Murphy ... 378,610
Dampers, adjusting device for, F. A. Garrett ... 378,671
Dental chair, J. W. Cooper ... 378,433
Die. See Coal hod die.
Digger. See Patato digger. Road digger.
Dish holder, C. H. Latham ... 378,692
Door check, Shaw & Gilfillan ... 378,728
Door closer, G. W. Rodecap ... 378,807
Draught shackle, vehicle, Botsford & Church ... 378,539
Drill. See Mining drill. Multiple drill.
Drilling machine, W. Wattie ... 378,747
Dropper. See Corn dropper.
Eaves trough hanger. H. B. Todd ... 378,530
Egg tester, R. Stuckwisch ... 378,853
Electric distribution, system of, T. Spencer, 378,737, 378,738
Electric generator regulator, W. S. Hill ... 378,547
Electric generator, self-exciting, alternate current, O. A. Moses ... 378,456
Electric wires or cables, conduit for, R. S. Waring ... 378,561
Electric wires or cables, test box for underground, R. S. Waring ... 378,560
Electrical conductors, underground conduit for, M. R. Muckle, Jr ... 378,801
Electrical conduits, manhole chamber for underground, M. R. Muckle, Jr ... 378,802
Electrical distribution, system of, Conant & Latshaw ... 378,432
Electrotype plates, bending, Miller & Dale ... 378,707
Elevator. See Hydraulic or other elevator. Tide water elevator.
Engine. See Steam engine. Traction engine.
Engines, electrical stop motion for steam, R. Exlep ... 378,668
Envelope, Potter & Upham ... 378,849
Erasers, cleaner for blackboard, J. S. McClung ... 378,608
Etching on one or both sides, J. Baynes ... 378,423
Evaporating apparatus, P. Laberie ... 378,598
Evaporating liquids, vacuum apparatus for, S. M. Lillie ... 378,843
Evaporator. See Fruit evaporator.
Excavator, B. K. Reed ... 378,720
Extractor. See Stump extractor.
Fabric. See Woven pile fabric.
Fabrics, apparatus for guiding, straightening and evening, S. Arnold ... 378,822
Fan power, J. Carr ... 378,659
Fan, rotary, W. J. Mingle ... 378,710
Fanning mill, J. S. Constant ... 378,772
Fastening device, C. H. Pratt ... 378,460
Feed trough, A. N. Main ... 378,608
Feed water purifier, E. G. T. Colles ... 378,495
Feeding bin and trough, J. T. Woods ... 378,536
Fence, J. F. Bazill ... 378,425
Fence, W. A. Frushour ... 378,832
Fence, W. Kelly ... 378,793
Fence machine, wire and picket, W. Dixon ... 378,777
Fertilizer, P. C. Jensen ... 378,688
Filter, Clarke & Conroy ... 378,431
Firearm, magazine, A. W. Savage ... 378,525
Fire escape, D. H. Sweeney ... 378,529
Fire escape, portable, G. Gavin *et al* ... 378,833
Fishing reel, P. H. Yauman ... 378,565
Flask clamp, adjustable, A. C. Allbee ... 378,640
Flies, device for poisoning, J. B. Kibler ... 378,509
Flour bolting reel, W. Gilleland ... 378,785
Fluid discharge device, C. N. Tyler ... 378,812
Fluid pressure, machine to be driven by, W. P. Canning ... 378,541
Fruit evaporator, E. White ... 378,483
Fur blower, T. J. Sayre ... 378,622
Furnace. See Blast furnace. Hydrocarbon furnace.
Furnace, Huidekoper & Houze ... 378,839
Gauge. See Weather boarding gauge.
Garment stretcher, F. Cadmus ... 378,764
Gas burner, incandescent, J. Mactear ... 378,699
Gas enriching apparatus, J. H. Amies ... 378,418
Gas from gas mains, means for carrying off escaping, J. W. Ellis ... 378,544
Gas lighting apparatus, electric, C. W. Holtzer ... 378,677
Gas, manufacturing water, R. Boeklen ... 378,490
Gate. See Railway gate.
Gate, C. Wilson ... 378,564
Generator. See Electric generator.
Glass, machinery for beveling the edges of plates of, O. C. Hawkes ... 378,680
Glove, D. B. Gunn ... 378,834
Grain binder, F. A. Murdock ... 378,845
Grain binders, knotting device for, W. N. Whiteley ... 378,815
Gravel, etc., box for washing, T. W. Carrico ... 378,765
Groats, separating machine for cleaning, E. Weiss ... 378,562
Gum, machine for manufacturing chewing, W. J. White ... 378,637
Gun, magazine, R. F. Cook ... 378,661
Gun, magazine, E. E. Redfield ... 378,556
Gunpowder press and grainer, P. A. Oliver ... 378,516
Hammer, nail, D. P. Bigelow ... 378,650
Hammer, steam pile driving, J. N. Warrington ... 378,745
Handle attachment, F. Brough ... 378,540
Hanger. See Car door hanger. Eaves trough hanger. Tobacco hanger.
Harrow for listed crops, H. A. Murphy ... 378,611
Harrow, sulky, M. S. & W. A. Doolittle ... 378,578
Harvester and binder, combined, Whiteley & Bayley ... 378,814
Harvester and thrasher, combined, M. P. Farnham ... 378,581
Harvester, corn, J. L. Lamont ... 378,551
Harvester, corn, D. T. Phillips ... 378,521
Harvester, grain binding, W. N. Whiteley ... 378,817
Hat sizing machines, felting roll for, A. T. Clark ... 378,573
Hay rake and loader, C. P. Slaght ... 378,466
Heater. See Hot water heater. Water or liquid heater.
Heel nailing machine, F. F. Raymond, 2d ... 378,617
Hide lifter and carrier for tanneries, A. M. Fletcher ... 378,670
Hinge, butt, Prescott & Locke ... 378,718
Hoe, R. S. Rinker ... 378,723
Hog trough, S. Corderman ... 378,434
Holdback, H. Hansberger ... 378,505
Holder. See Corn holder. Dish holder. Mop holder. Sandpaper holder. Slate pencil holder.
Hook. See Check hook. Trolling spoon hook.
Hoop dressing machine, J. J. Moger ... 378,454
Horse head protector, H. Zeffertt ... 378,558
Hose coupling, Atherton & Bentley ... 378,566
Hot water heater, J. M. Thayer ... 378,633
Hub, wheel, C. A. Kinney ... 378,842
Hydraulic motor, G. W. Mason ... 378,761
Hydraulic or other elevator, W. P. Gibson ... 378,674
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Mowing machine, Whiteley & Bayley ... 378,816
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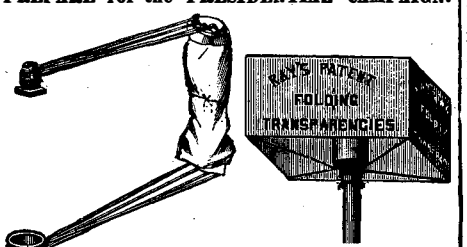

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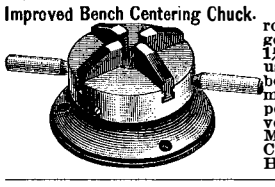

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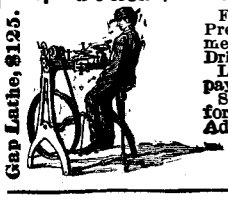

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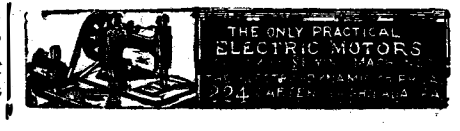

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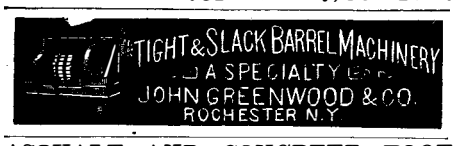

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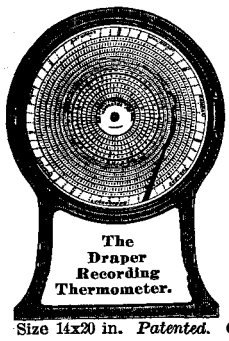

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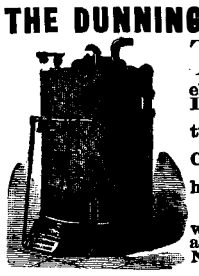

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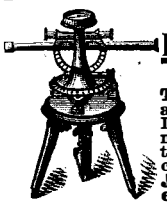

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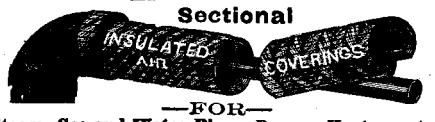

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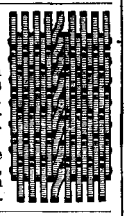

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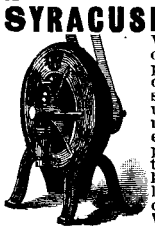

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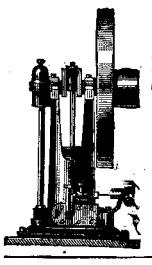

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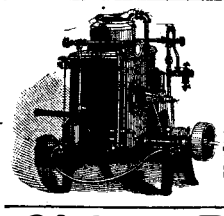

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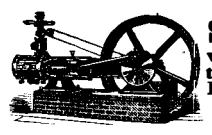

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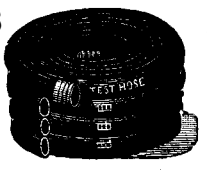

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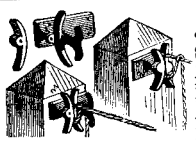

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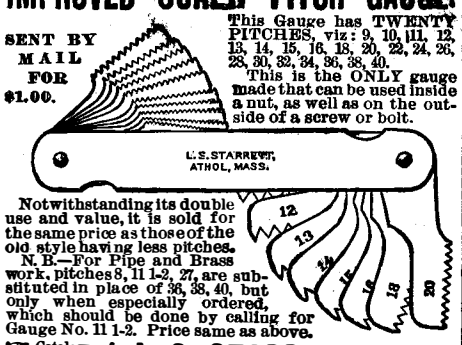

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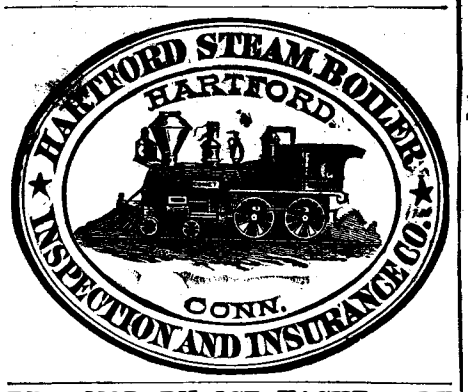

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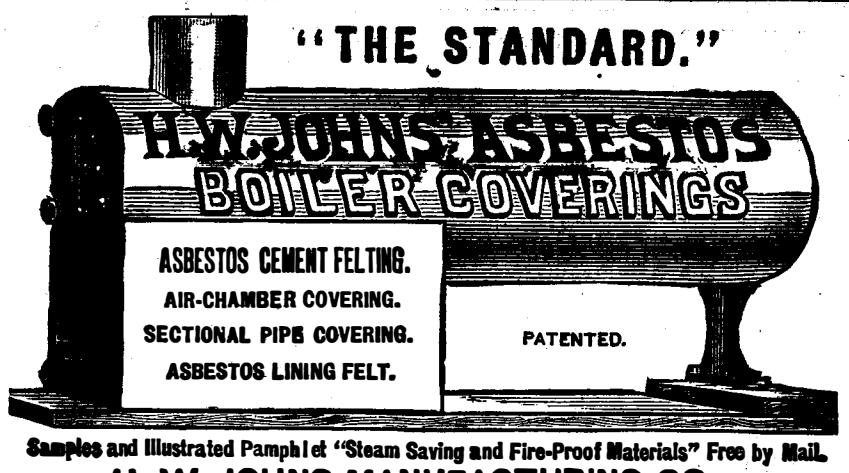

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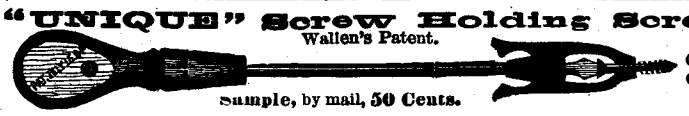

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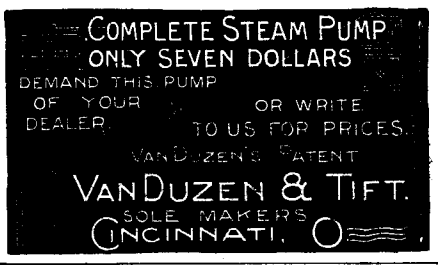

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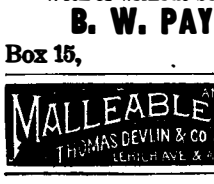

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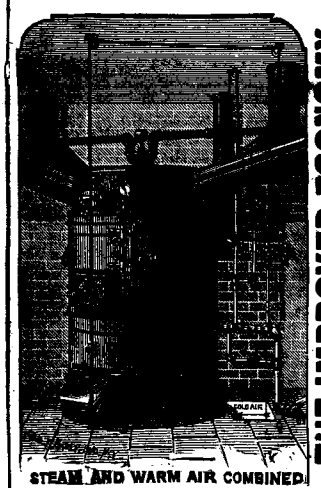

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